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YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS

ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM

1981

National Park Service
U.S. Forest Service
Montana Fish and Game Department
U.S. Fish and Wildlife Service
Idaho Fish and Game Department
Wyoming Game and Fish Department

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INTRODUCTION

The Interagency Grizzly Bear Study Team, initiated in 1973, is a cooperative effort of the National Park Service, Fish and Wildlife Service, Forest Service, and since 1974 the States of Wyoming, Montana, and Idaho. This research provides immediate and long range information needed by various management agencies on the grizzly bears *(Ursus arctos horribilis)* that inhabit the Yellowstone system. With increasing demands on most resources in the area, it is apparent that current quantitative data on grizzly bears is urgently required for management decisions.

Earlier research on grizzlies within Yellowstone National Park provided data for the period 1959-67 (Craighead et al. 1974). However, changes in management operations by the Park Service since 1967 - mainly the closing of open pit garbage dumps - have markedly changed some habitat and population parameters (Meagher and Phillips 1980). Thus, current research efforts are needed to define and evaluate grizzly bear population dynamics. Objectives of the study are to determine the status and trend of the grizzly bear population, the use of habitats and food items by the bears, and the effects of land management practices on the bear population.

Distribution of grizzly bears within the study area, movement patterns, and habitat use have been largely determined and are now being studied on a monitoring and updating level. Efforts are being concentrated on gathering population data, determining behavior patterns, and assessing the effects of land use practices adjacent to the park boundary.

Movement data conclusively indicates that the existence of semiautonomous population segments is unlikely and that the determination of population size will be difficult due to the average home range sizes of individual bears. Population trend indices appear to be more meaningful and measurable than a number estimate.

Major objectives for 1981 were as follows:

1. Obtain as much data as possible on early spring and late fall food habits and habitat use.

2. Capture and reinstrument yearlings and 2-year-old bears instrumented in 1980, with the addition of any new bears that are caught in the process.

3. Continue community analysis mapping of areas needed for analysis of habitat preference.

An annotated list of major and minor objectives is given in the 1981 Work Plan (Appendix A).

This study is funded by the National Park Service, the U.S. Fish and Wildlife Service, and the State of Wyoming. Cooperating agencies include

Yellowstone National Park, the U.S. Forest Service, and the State wildlife departments of Idaho and Montana. The assistance of many Interagency Grizzly Bear Study (IGBS) seasonal technicians and pilots, Dave and Roger Stradley, is gratefully acknowledged, as are the Forest Service district personnel and Yellowstone Park in providing field facilities.

MOVEMENTS AND OBSERVATIONS

PROCEDURES

Grizzly bear movements were determined by radio telemetry techniques. Bears were trapped in culvert traps and Aldrich foot snares, fitted with radio transmitters, and released. Telonics transmitters were attached to neck collars which were constructed with two-ply conveyor belting and uralane plastic. Collars were fitted to the adult bears using a decomposable cotton strip to connect the belting ends. Collars on subadult bears were connected with elastic shock cords (Knight et al. 1980)

Radio-tracking flights were made approximately twice a week. Types of antennas and tracking techniques were described by Knight et al. (1978). Aerial locations of radio-collared bears were plotted on U.S. Geological Survey topographical maps to within a 100-m^2 plot using the Universal Transverse Mercator system.

Observations of unmarked bears were obtained during aerial flights, ground reconnaissance, and from verified reports.

Previous evaluation of several methods traditionally used to determine home range sizes indicated that the minimum area method (Stickel 1954) gave the best representation of a grizzly bear's range size, shape, and habitat preferences (Knight et al. 1978). A biological center of activity (bio-center) is defined as a clumping of radio locations resulting from intensive use of a relatively small area (Ables 1969). Bio-centers were identified by the length of time spent within the area (minimum 7 days) and/or the number of return visits to that area (minimum four returns). Excursions are sudden, apparently straight line exit and return movements outside a bear's normal range during a short time period. Composite home ranges were calculated for grizzly bears monitored at least 2 years and located a minimum of 60 times.

RESULTS

Movements

Since 1975, 80 grizzly bears have been fitted with radio collars and monitored for varying lengths of time (Fig. 1). Thirty of these bears were known or suspected to be dead at the end of the 1981 field season (Table 1). Eighty-three percent of these deaths were man-caused. Only 39 of the total 80 bears were known to be alive during 1981.

During 1981, 36 different grizzlies were captured 65 times, including 19 adults, 10 subadults, 5 yearlings, and 2 cubs (Table 2). Twelve were adult females and four were weaned subadult females.

Grizzlies were captured at 21 trap locations throughout the study area (Fig. 2). Seventeen grizzly bears were captured at eight different

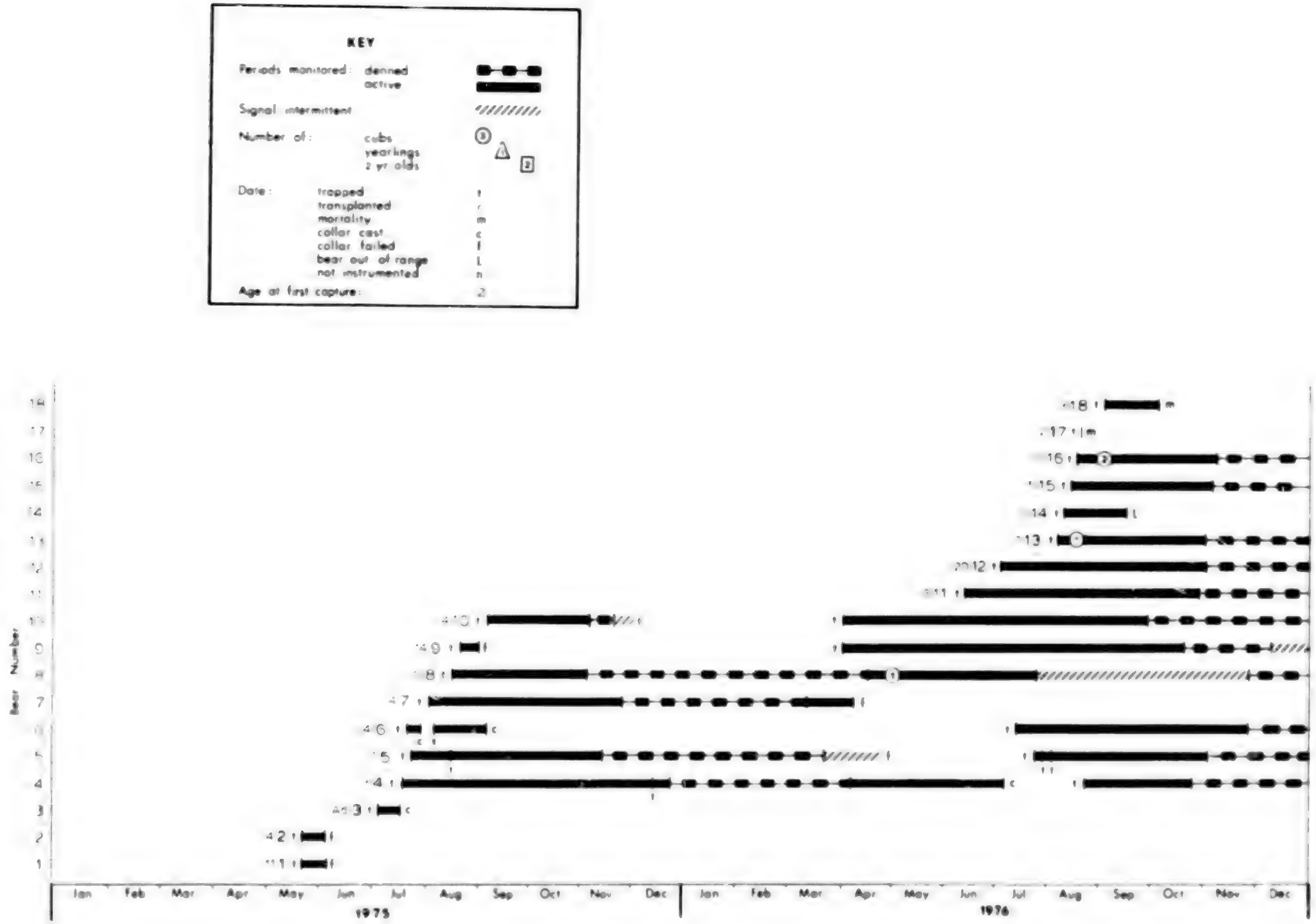
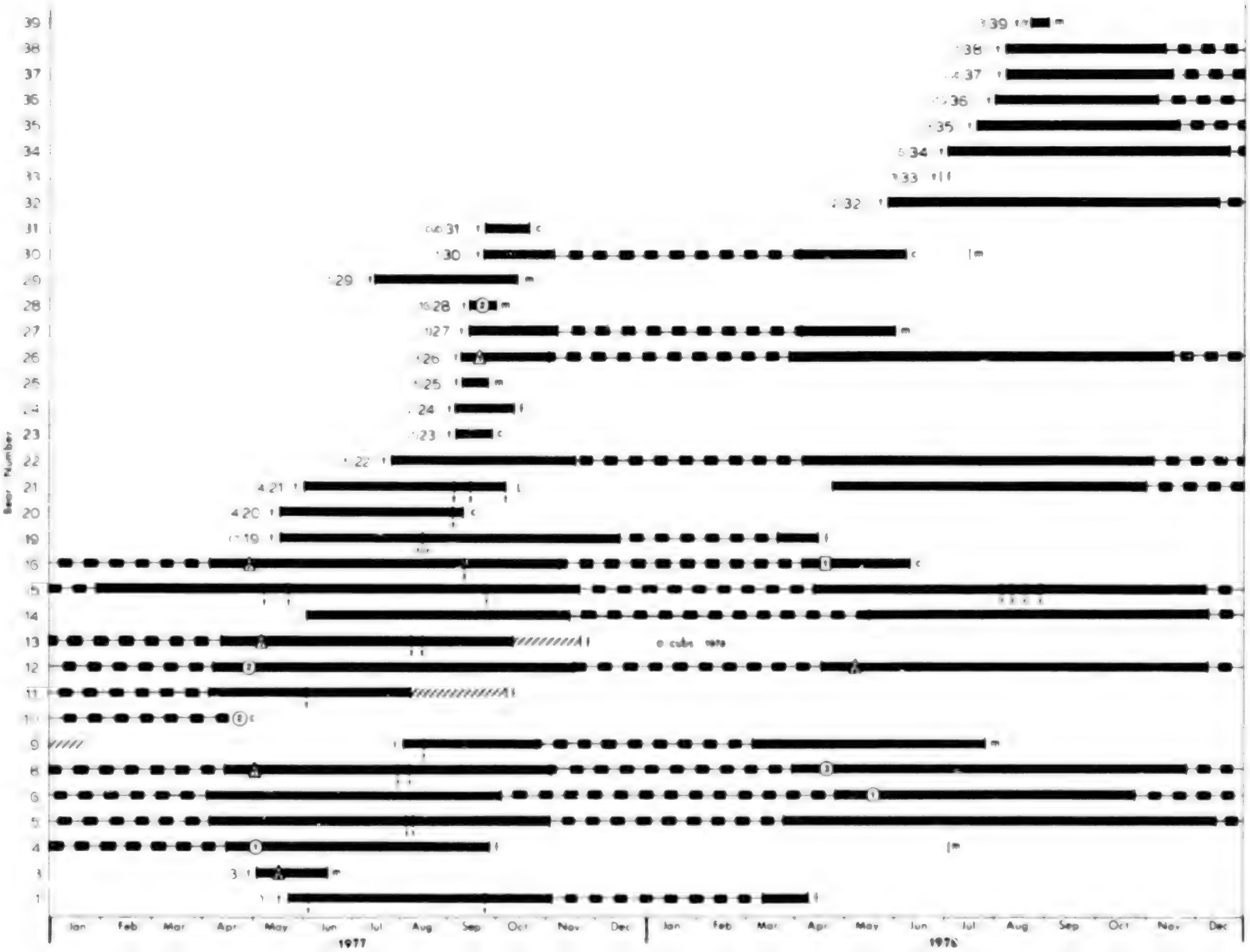


Fig. 1. Histories of radio-collared grizzly bears, 1975-81.

Fig. 1. (continued)



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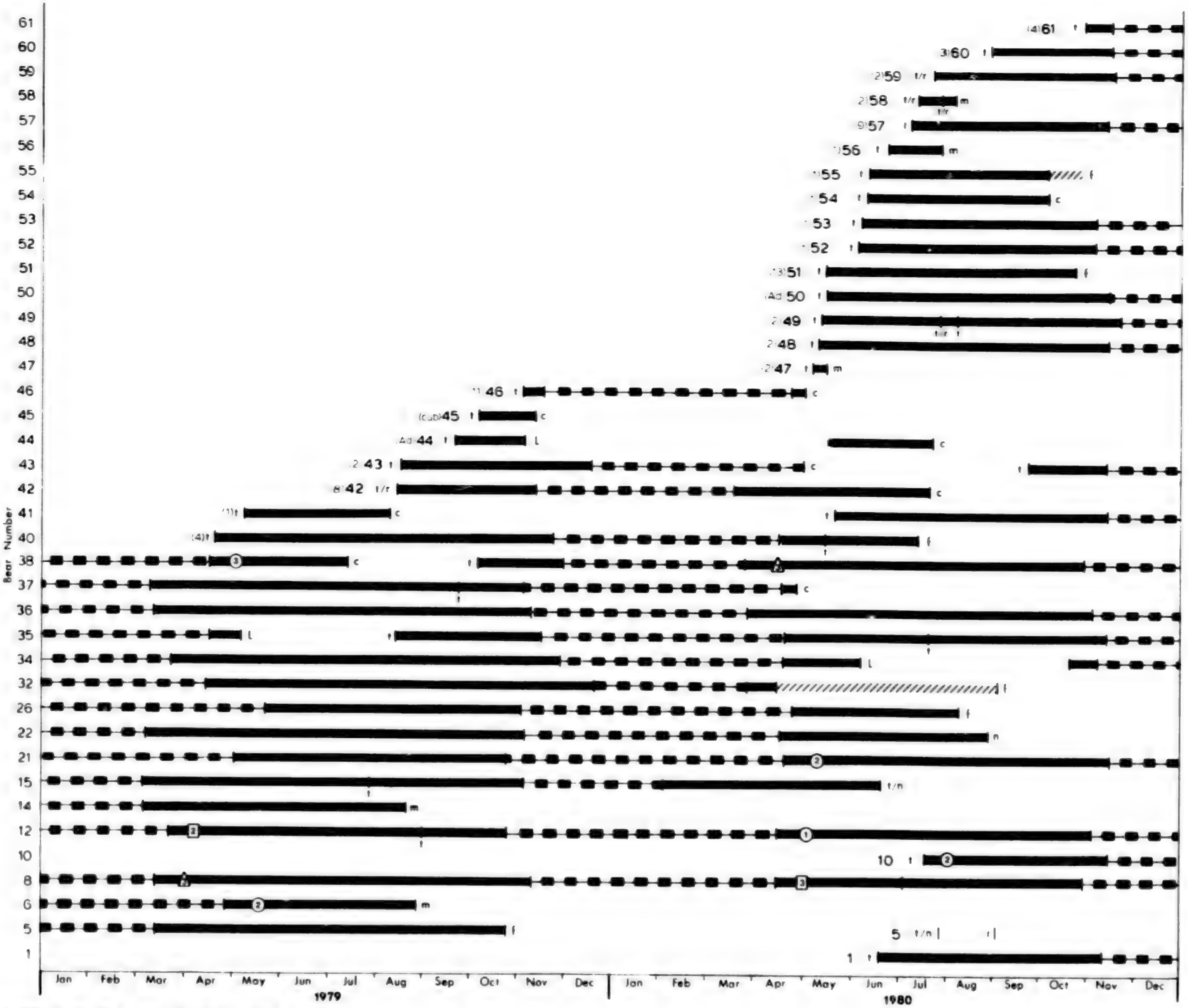

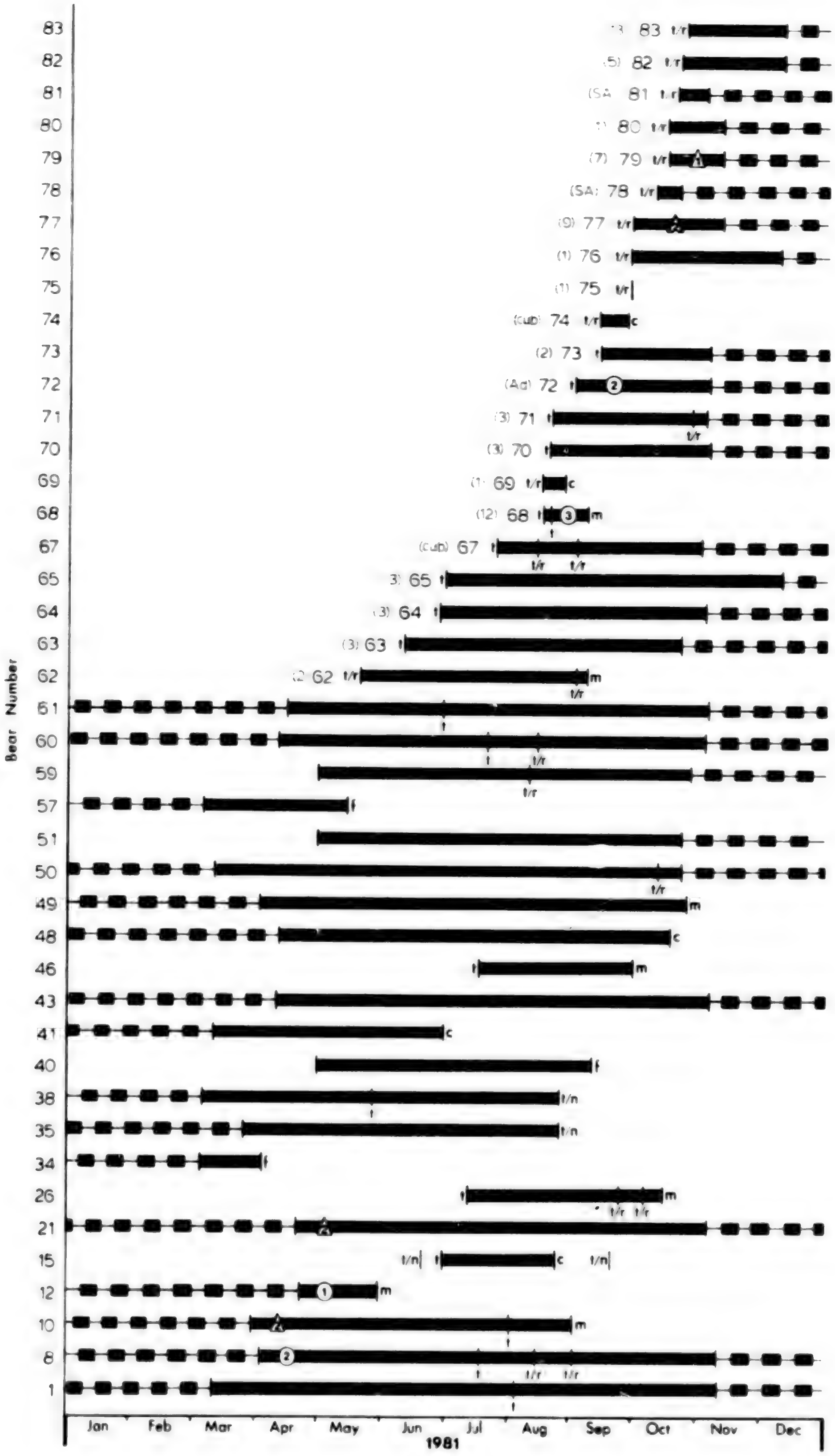

Fig. 1. (continued)

Table 1. Status of instrumented grizzly bears, 1975-1981 (N = 80)

	Number	Percent
KNOWN DEAD	21	26%
Man-caused	19	24%
Natural	2	2%
Adult female	6	
Adult male	4	
Subadult	11	
SUSPECTED DEAD	9	11%
Man-caused	6	8%
Natural	3	3%
Adult female	2	
Adult male	1	
Subadult	6	
OFF AIR	24	30%
Believed alive	12	15%
Unknown	12	15%
Adult female	3	
Adult male	13	
Subadult	8	
ACTIVE	26	33%
Adult female	7	
Adult male	4	
Subadult	15	

Table 2 . Grizzly bears trapped during 1981

Bear	Sex	Age[1]	Date trapped		Location trapped	Wt[2]	Relocation site
1	M	17	08-04	RI[3]	S. Crandall, WY	325*	
5	M	13	08-14	NIL	Cooke City, MT		The Crags, YNP
"			08-31	RTL	Slough Cr G.S., MT		Red Cr, WY
8	F	15	07-17	RI	Woody Cr, MT	300	
"			08-14	RTL	Cooke City, MT		Saddle Mtn, YNP
"			09-02	RTL	Cooke City, MT		Surprise Cr, YNP
10	F	10	08-02	RI	Woody Cr, MT	428*	
13	F	12	07-23	NI	Woody Cr, MT	335*	
"			07-24&25	RT	Woody Cr, MT		
"			08-04	RT	Woody Cr, MT		
15	M	10	06-29	RI	Fir Ridge, MT	350	
"			09-20	NI	Fir Ridge, MT	425	
26	F	22	07-11	RI	Grebe Lk, YNP	200	
"			09-23	RTL	Mikolich res.,MT		Blacktail Cr,YNP
"			10-06	RTL	Mikolich res.,MT		Arnica Cr, YNP
35	M	6	08-25	NI	Tepee Cr, MT	400	
38	F	10	05-27	RT	Fir Ridge, MT	375	
"			08-25	NI	Tepee Cr, MT	400	
46	M	Ad	07-16	RI	Woody Cr, MT	325-350	
50	F	Ad	10-12	RTL	W. Entr., YNP		Turbid Lk, YNP
59	F	3	08-12	RTL	Canyon, YNP		Death Ridge, YNP
60	F	4	07-20	RI	Woody Cr, MT	235*	
"			08-14	RTL	Cooke City, MT		Cooke Pk, YNP
61	M	5	06-28	RT	Cap & Ball Pk, WY	330*	
62	M	2	05-20	IL	Pahaska Tepee, WY	150*	Sunlight Cr, WY
"			09-03	RIL	Pahaska Tepee, WY	225	Younts Cr, WY
63	M	3	06-10	I	Cap & Ball Pk, WY	265*	
64	F	3	06-26	I	Antelope Cr, YNP	175	
65	M	3	06-29	I	Antelope Cr, YNP	220	
67	F	Cub	07-23	I	Cooke City, MT	50*	
"			07-26	RT	Cooke City, MT		
"			08-06	RT	Woody Cr, MT		
"			08-13	RTL	Cooke City, MT		Saddle Mtn, YNP
"			09-01	RTL	Cooke City, MT		Surprise CR, YNP
68	F	12	08-17	I	2 Ocean Plateau, YNP	250-275	
"			08-20	RT	2 Ocean Plat. YNP		
69	F	1	07-31	NI	Cooke Pass, MT	137*	
"			08-01	RT	S Crandall, WY	137*	
"			08-16	IL	Cooke City, MT	135	Grayling Cr, YNP
70	M	3	08-19	I	2 Ocean Plateau, YNP	250-300	
71	M	3	08-21	I	Fawn Pass, YNP	275	
"			08-22&24	RT	Fawn Pass, YNP		
"			10-26	RTL	Blanding R.S., MT		Snake R., YNP

Table 2. Grizzly bears trapped during 1981
(continued)

Bear	Sex	Age[1]	Date trapped		Location trapped	Wt[2]	Relocation site
72	F	Ad	09-02	I[3]	Buffalo Valley,WY	350	
73	M	2	09-13	IL	Little Bear Lk,WY	185*	Cap & Ball Pk,WY
74	M	Cub	07-24	NI	Cooke City, MT	52*	
"			07-26	RT	Cooke City, MT		
"			08-06	RT	Woody Cr, MT		
"			08-13	RTL	Cooke City, MT		Saddle Mtn, YNP
"			09-01	RTL	Cooke City, MT		Surprise Cr, YNP
"			09-13	RTL	Grant Village,YNP	75*	Mirror Plat.,YNP
75	F	1	09-24	IL	Mikolich res., MT	170*	Blacktail Plateau, YNP
76	F	1	09-25	IL	Mikolich res., MT	110	Blacktail P.,YNP
77	F	9	09-27	IL	Mikolich res., MT	300*	Blacktail Cr,YNP
78	M	2	10-07	IL	Mikolich res., MT	250	Grebe Lk, YNP
79	F	7	10-14	IL	Blanding R.S., MT	255*	Grebe Lk, YNP
80	M	1	10-14	IL	Blanding R.S., MT	100	Grebe Lk, YNP
81	M	3	10-05	NIL	Lake, YNP		Blacktail P.,YNP
"			10-17	IL	Lake, YNP	295*	Divide Lk, YNP
82	F	5	10-21	IL	Lake, YNP	250	Rose Cr, YNP
83	F	13	10-23	IL	Lake, YNP	285*	Rose Cr, YNP
"			10-31	RTL	Lake, YNP		Glen Cr, YNP
G-12	M	1	08-07	NI	Cooke Pass, MT	125*	
"			08-16	NIL	Cooke City, MT		Grayling Cr, YNP

[1] Ad = adult, males over 4 years old and females over 5 years old.

[2] Weight in pounds; * indicates scale weight.

[3] I = Instrumented with transmitter
NI = Not instrumented
RI = Reinstrumented
RT = Retrapped; not reinstrumented
L = Transplanted

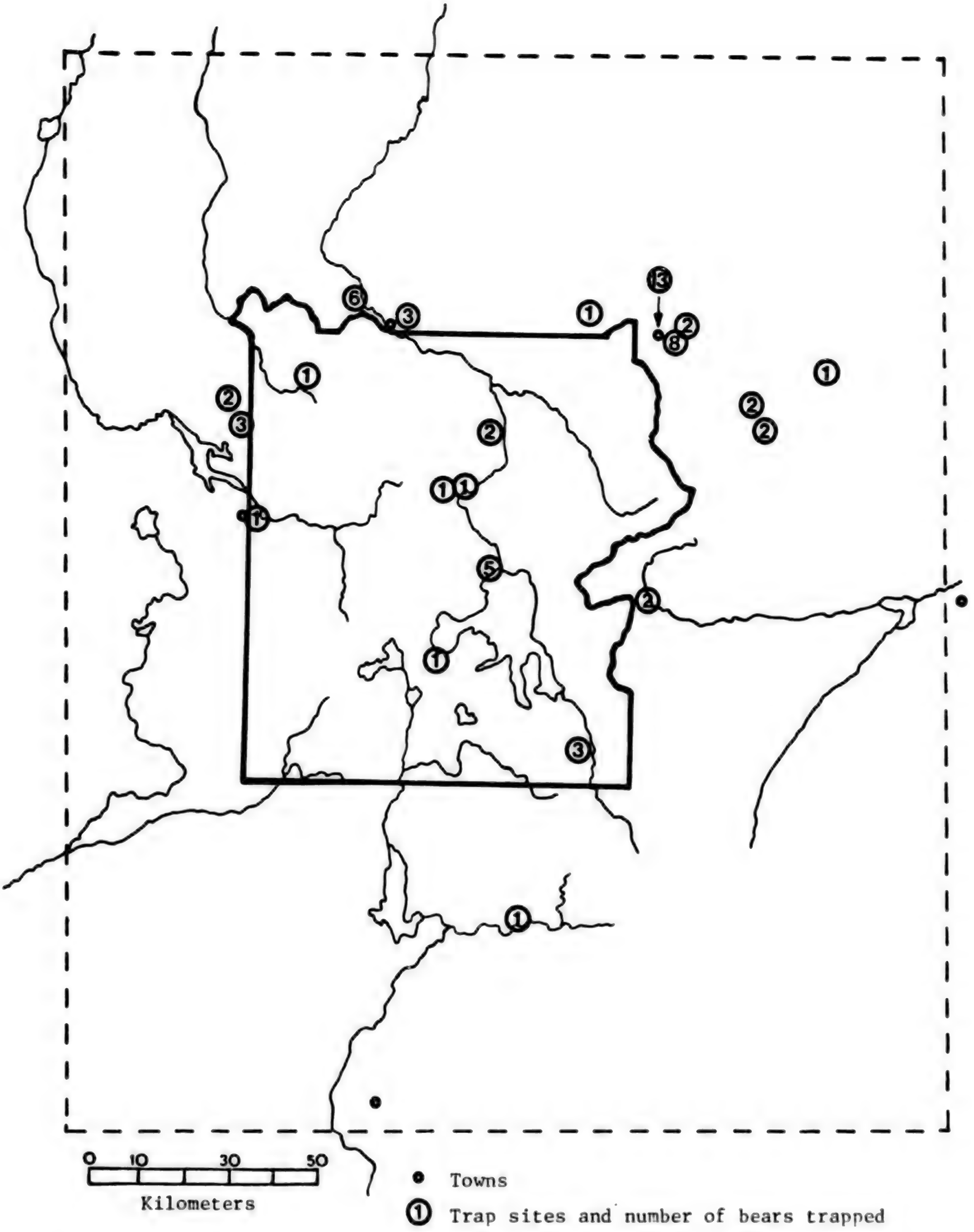

Fig. 2. Study area boundaries and 1981 trap sites.

locations within Yellowstone Park, 40 bears at eight locations in Montana, and eight bears at five locations in Wyoming. Captures of 35 grizzlies at 10 of these locations were the results of cooperative interagency management control actions by Yellowstone Park and the States of Montana and Wyoming. (See section "Conflicts with Man.")

Forty-three bears were monitored during 1981 (Table 3) compared to 34, 22, and 23 during 1980, 1979, and 1978, respectively. Due to the increased number of bears monitored and their wide distribution over the study area, each bear was located fewer times than during years previous to 1980. Each bear was located an average of once every 10 days in 1981, compared to once every 11, 8, and 7 days during 1980, 1979, and 1978, respectively. Therefore, annual range use areas did not accurately depict the shape and size of a bear's home range.

Composite home ranges were calculated for 23 grizzly bears which were monitored for a minimum of 2 years with at least 60 relocations (Table 4; Figs. 3, 4, and 5). Eleven adult males had an average home range size of 318 mi^2, ranging from 178 mi^2 to 633 mi^2; 11 females had an average range size of 178 mi^2, ranging from 72 mi^2 to 345 mi^2; 1 subadult male used 216 mi^2 during 3 years. The mean home range size of adult males was significantly different ($t = 2.84$; $\underline{P} < 0.01$) from that of adult females.

Seventeen of the 43 monitored grizzly bears ceased providing data during the year. Eight bears died, five cast their collars, two transmitters apparently failed, and two bears were released without replacement transmitters.

Observations

The 1981 distribution of verified observations of unmarked grizzly bears (Fig. 6) did not differ significantly from the composite distribution of sightings from 1970 through 1981 (Fig. 7). Several nonverified sightings of grizzlies were reported on the east side of the study area in 1981. This was probably related to food shortage and subsequent wider ranging movements of the Yellowstone grizzlies. (See "Conflicts with Man" section.)

Aerial observations of unmarked and radio-marked grizzly bears differed by season and reproductive status.

Unmarked females with cubs were consistently observed most frequently during the month of July each year from 1978 through 1981 (Fig. 8). Observability of all unmarked bears varied from year to year but was generally characterized by increased observations during April or May and again in July or August (Fig. 9). Observability of radio-marked bears was unpredictable (Fig. 10).

Forty-three of the 75 aerially observed unmarked grizzlies were females and their young, while observed radio-marked bears were usually alone or in breeding pairs.

Table 3. Grizzly bears monitored during 1981

Bear No.	Sex	Age	No. locations	Interval (days)
1	M	17	26	365
8	F	15	47	365
10	F	10	26	246
12	F	25	12	150
15	M	10	15	58
21	F	8	15	365
26	F	22	22	97
34	M	9	4	93
35	M	6	30	237
38	F	10	32	237
40	M	6	10	365
41	M	3	13	180
43	F	4	26	310
46	M	Ad	13	78
48	F	3	38	291
49	M	3	5	140
50	F	Ad	44	365
51	M	14	16	365
57	M	10	9	134
59	F	3	38	365
60	F	4	43	365
61	M	5	26	365
62	M	2	16	112
63	M	3	10	205
64	F	3	25	189
65	M	3	24	186
67	F	Cub	24	162
68	F	12	4	23
69	F	1	6	12
70	M	3	11	135
71	M	3	18	133
72	F	Ad	7	115
73	M	2	7	110
74	M	Cub	7	16
75	F	1	3	2
76	F	1	9	96
77	F	9	10	95
78	M	2	5	84
79	F	7	7	78
80	M	1	7	78
81	M	3	7	74
82	F	5	7	72
83	F	13	6	70

Table 4. Composite home range sizes of Yellowstone grizzly bears

Bear	Sex	Age[1]	Range size (mi^2)	No. years	No. locations
1	M	Ad	244	4	77
4	F	SAd-Ad	160	3	160
5	M	Ad	357	5	191
6	F	Ad	252	4	225
8	F	Ad	163	7	312
9	M	Ad	178	3	72
10	F	Ad	72	4	85
11	F	Ad	89	2	65
12	F	Ad	254	6	281
13	F	Ad	345	2	106
14	M	Ad	633	3	90
15	M	SAd-Ad	310	6	214
16	F	Ad	217	3	142
19	M	Ad	204	2	60
21	F	SAd-Ad	142	5	159
22	M	Ad	233	4	126
26	F	Ad	212	5	197
32	M	SAd	216	3	70
34	M	Ad	190	4	75
35	M	SAd-Ad	362	4	105
36	M	Ad	485	3	96
38	F	Ad	90	4	138
40	M	Ad	300	3	77

[1] Age during years used to calculate range size:
Ad = adult - 5 years and older
SAd = subadult - under 5 years

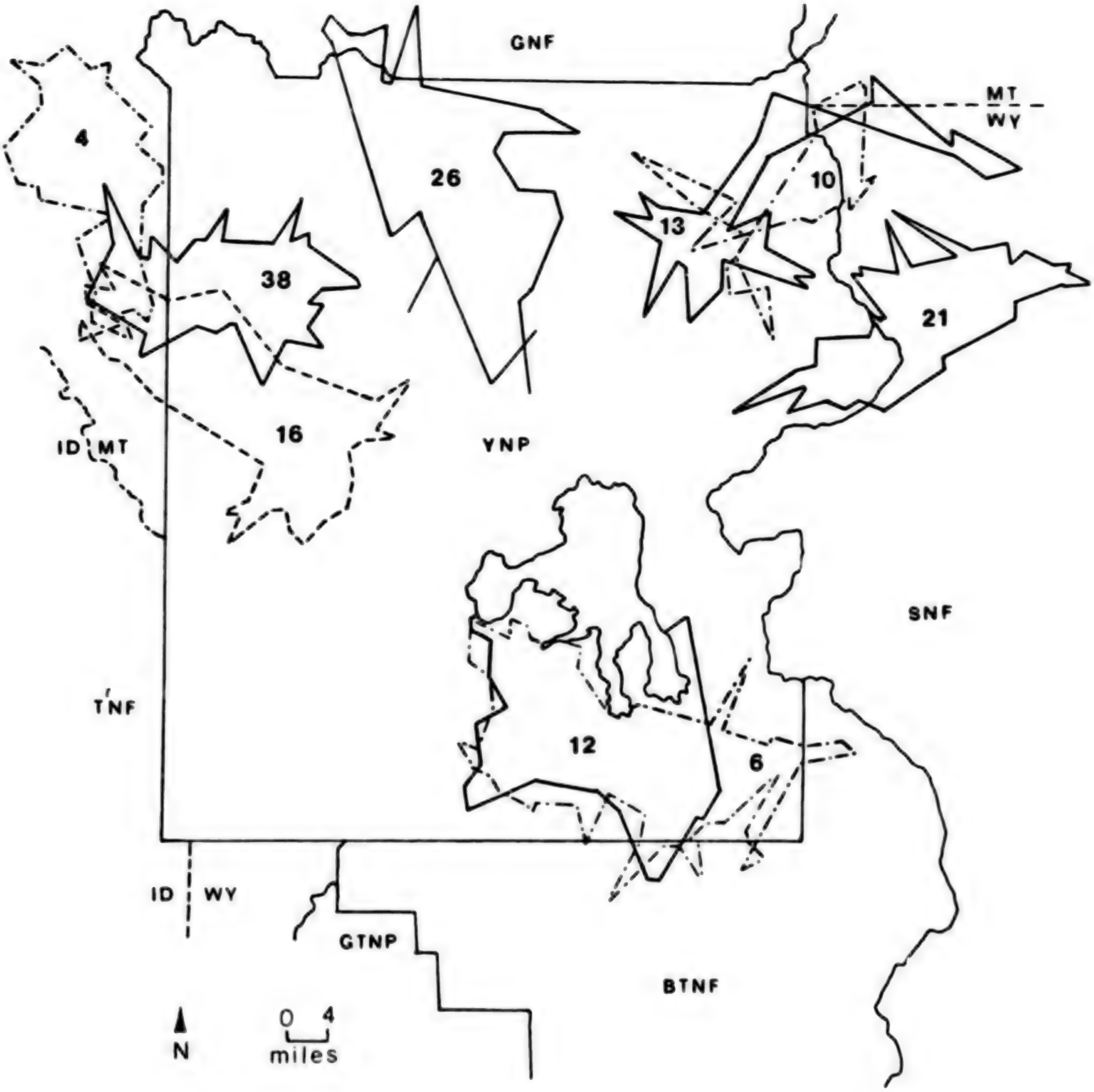

Fig. 3. Home ranges of nine adult female grizzly bears.

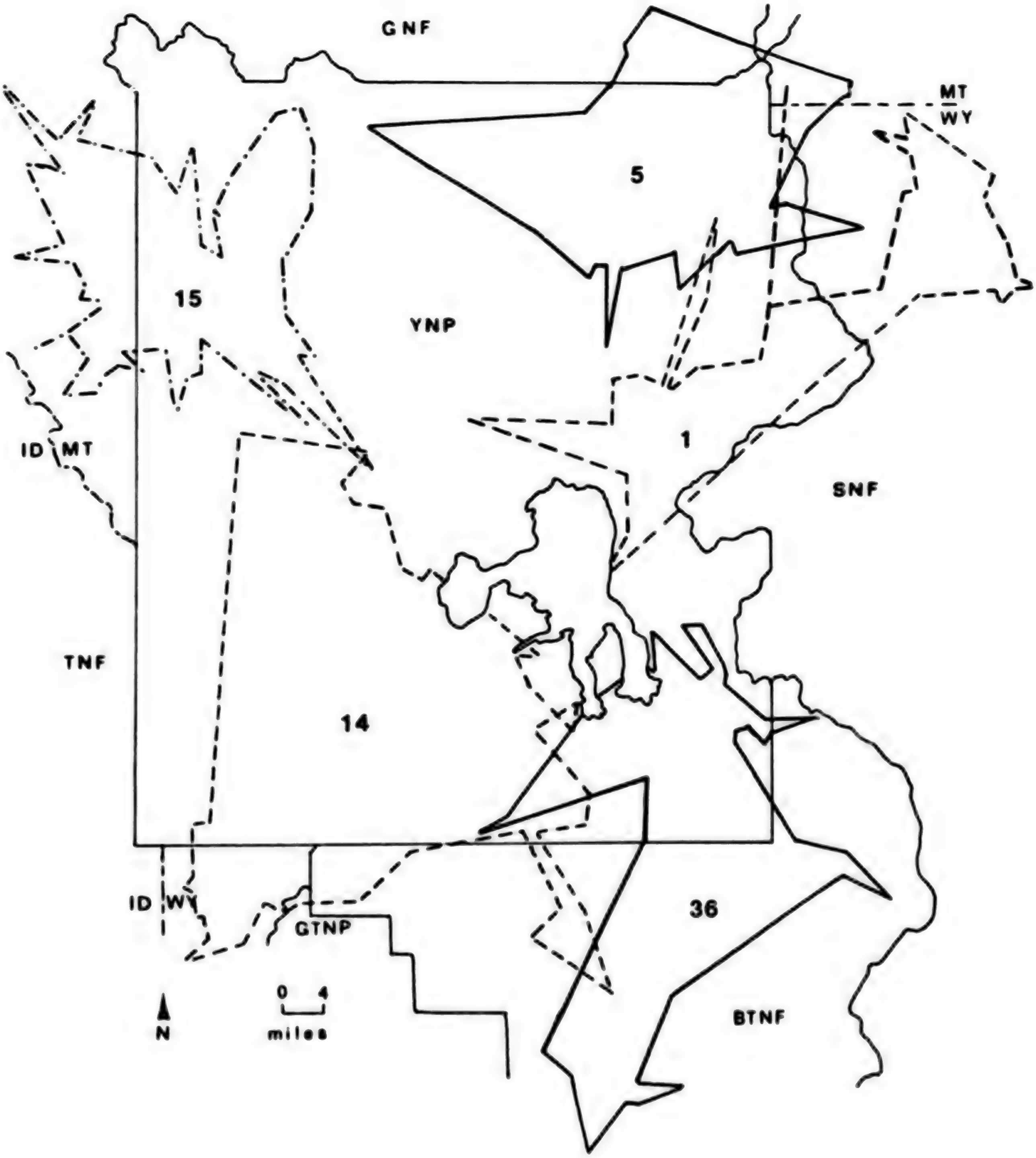

Fig. 4. Home ranges of five adult male grizzly bears.

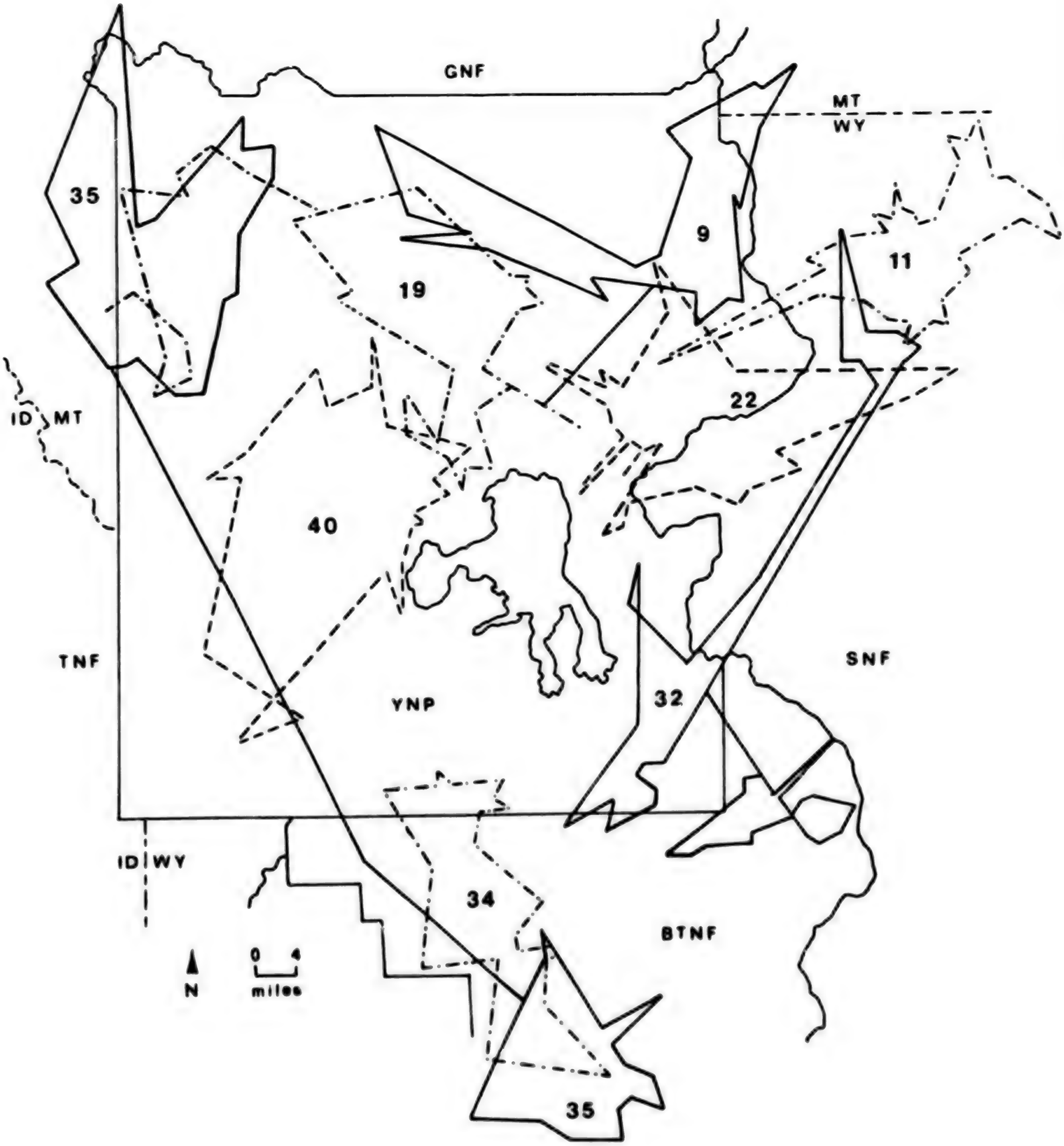

Fig. 5. Home ranges of eight male grizzly bears.

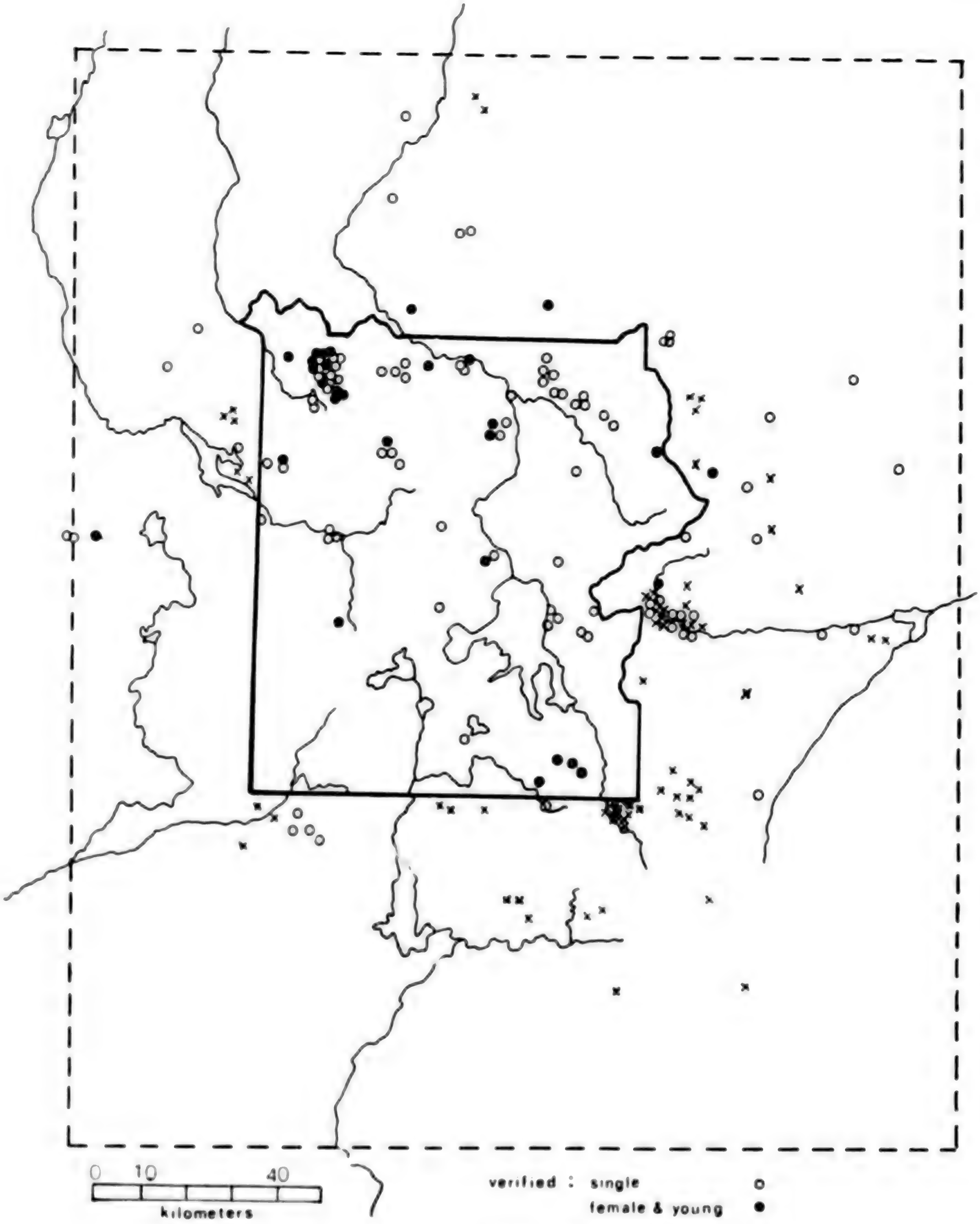

Fig. 6. Observations of unmarked grizzly bears during 1981.

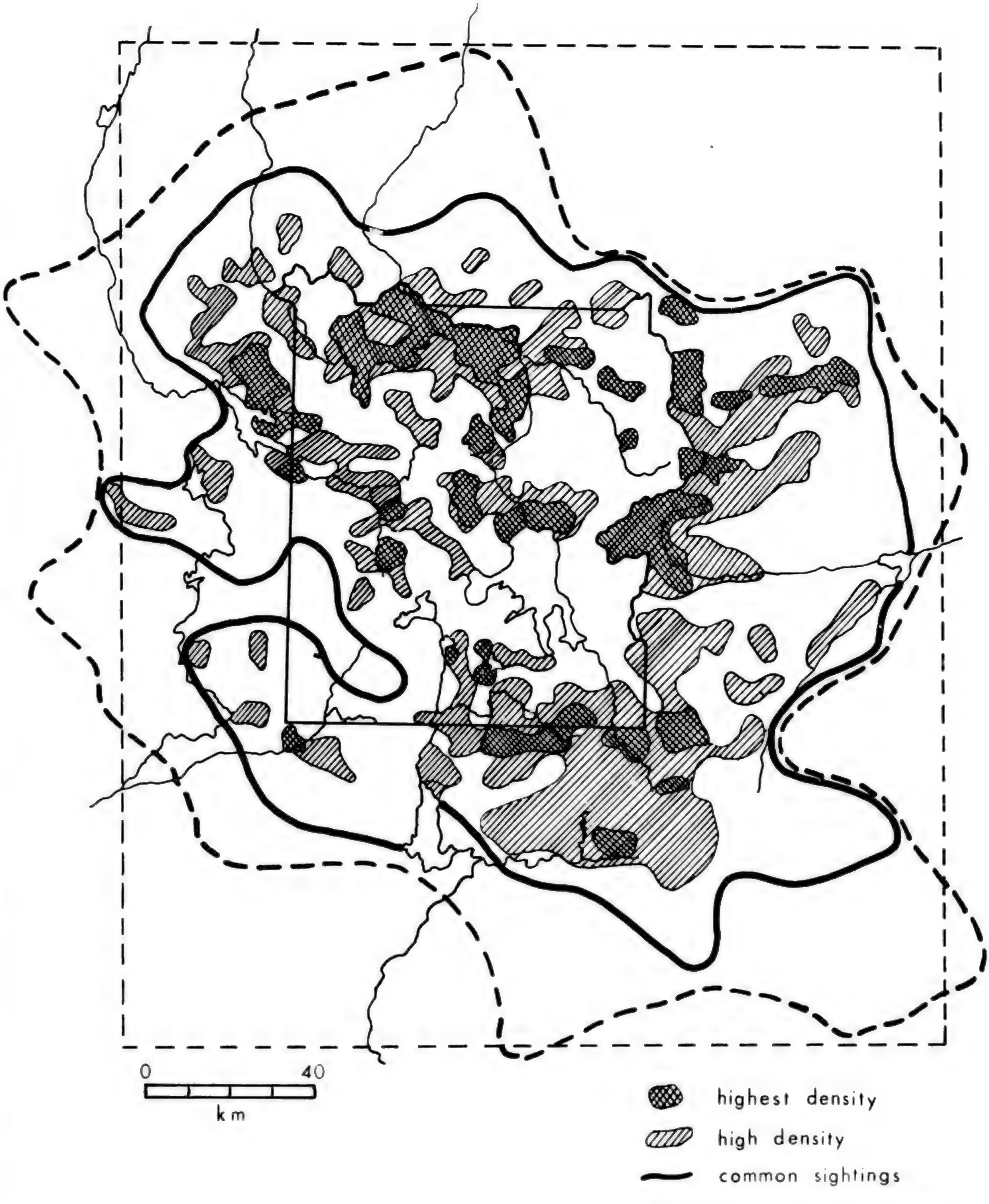

Fig. 7. Distribution of sightings of unmarked grizzly bears, 1970-81.

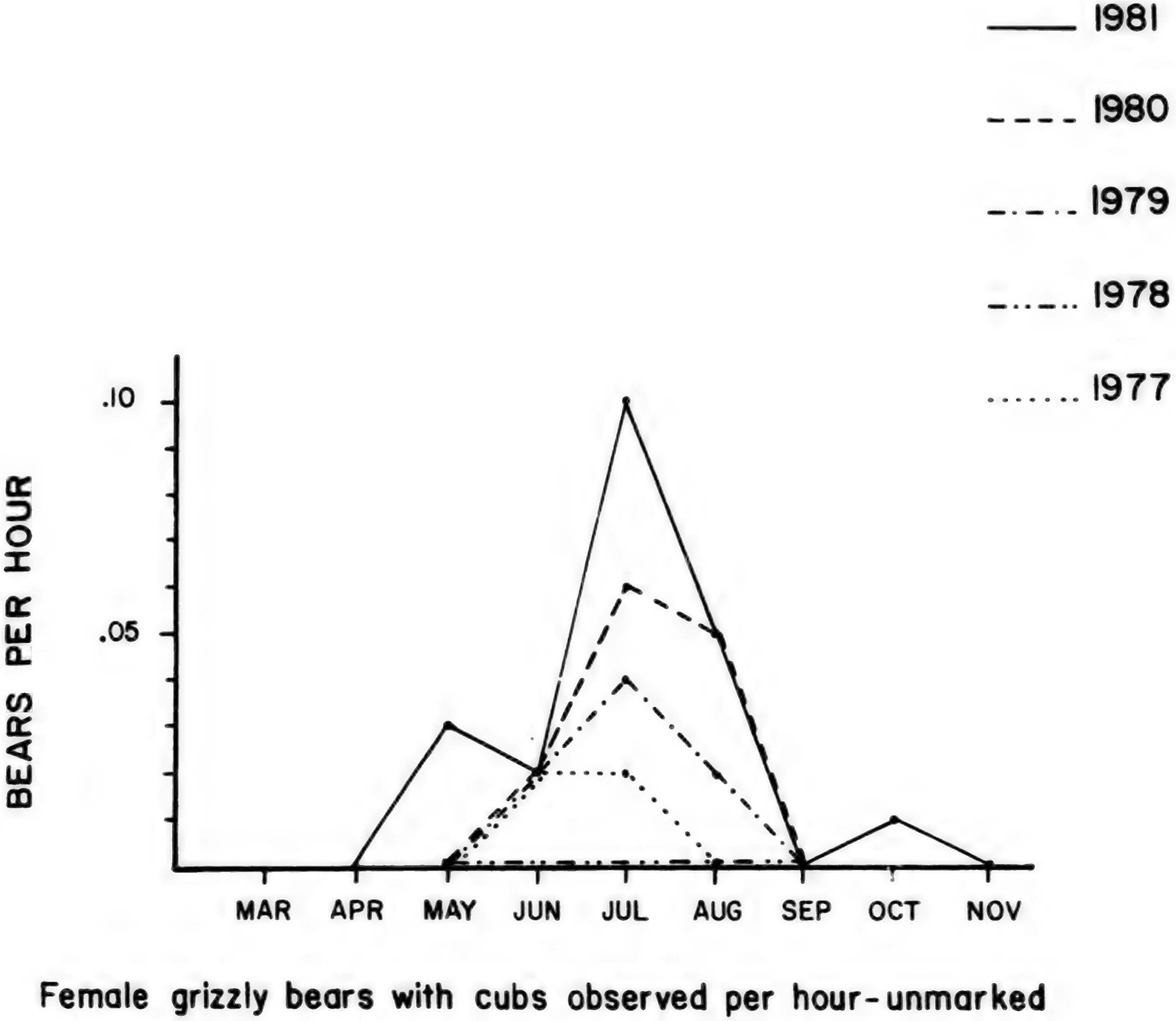

Fig. 8. Frequency of aerial observations of unmarked female grizzly bears with cubs.

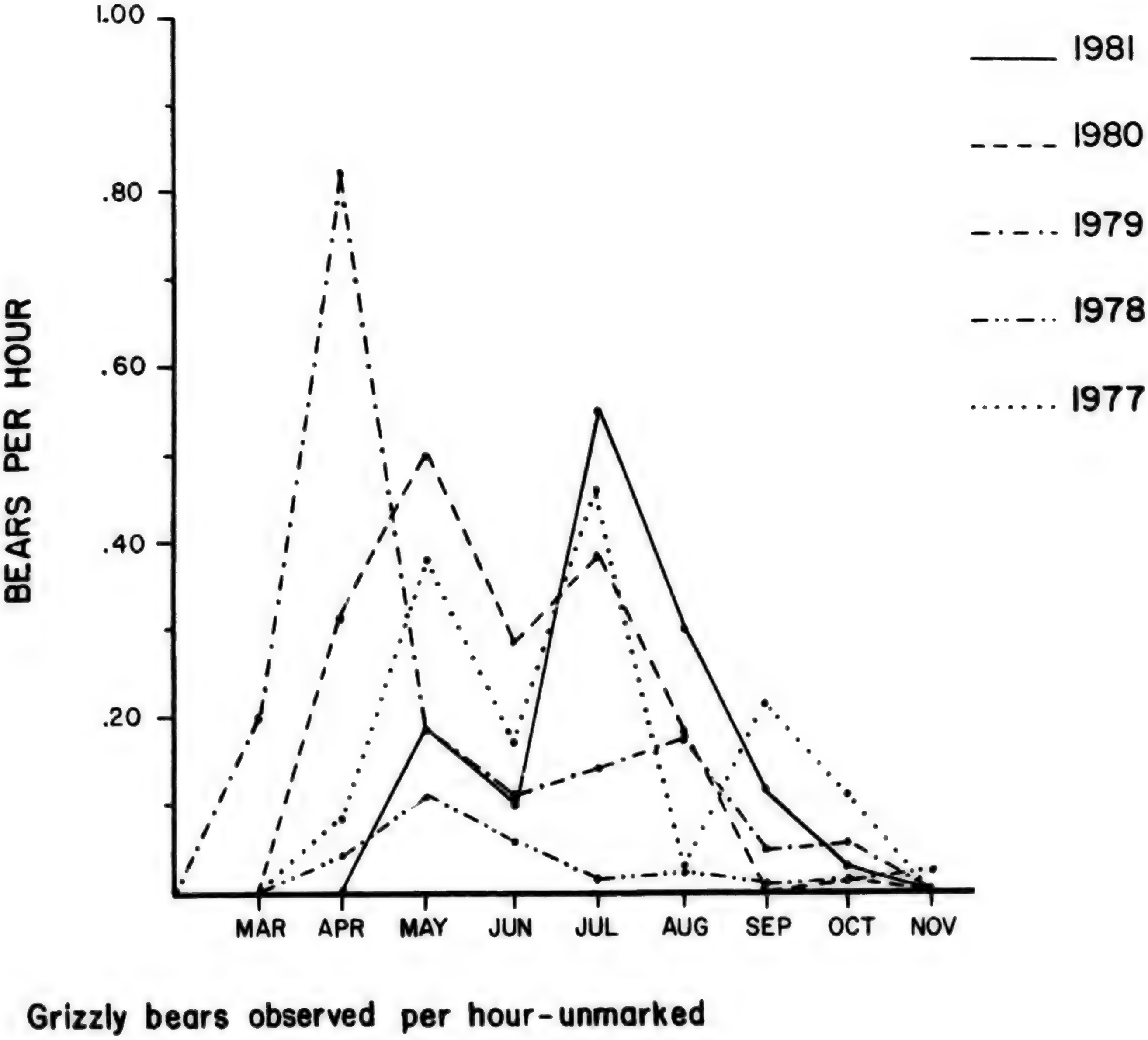

Fig. 9. Frequency of aerial observations of unmarked grizzly bears.

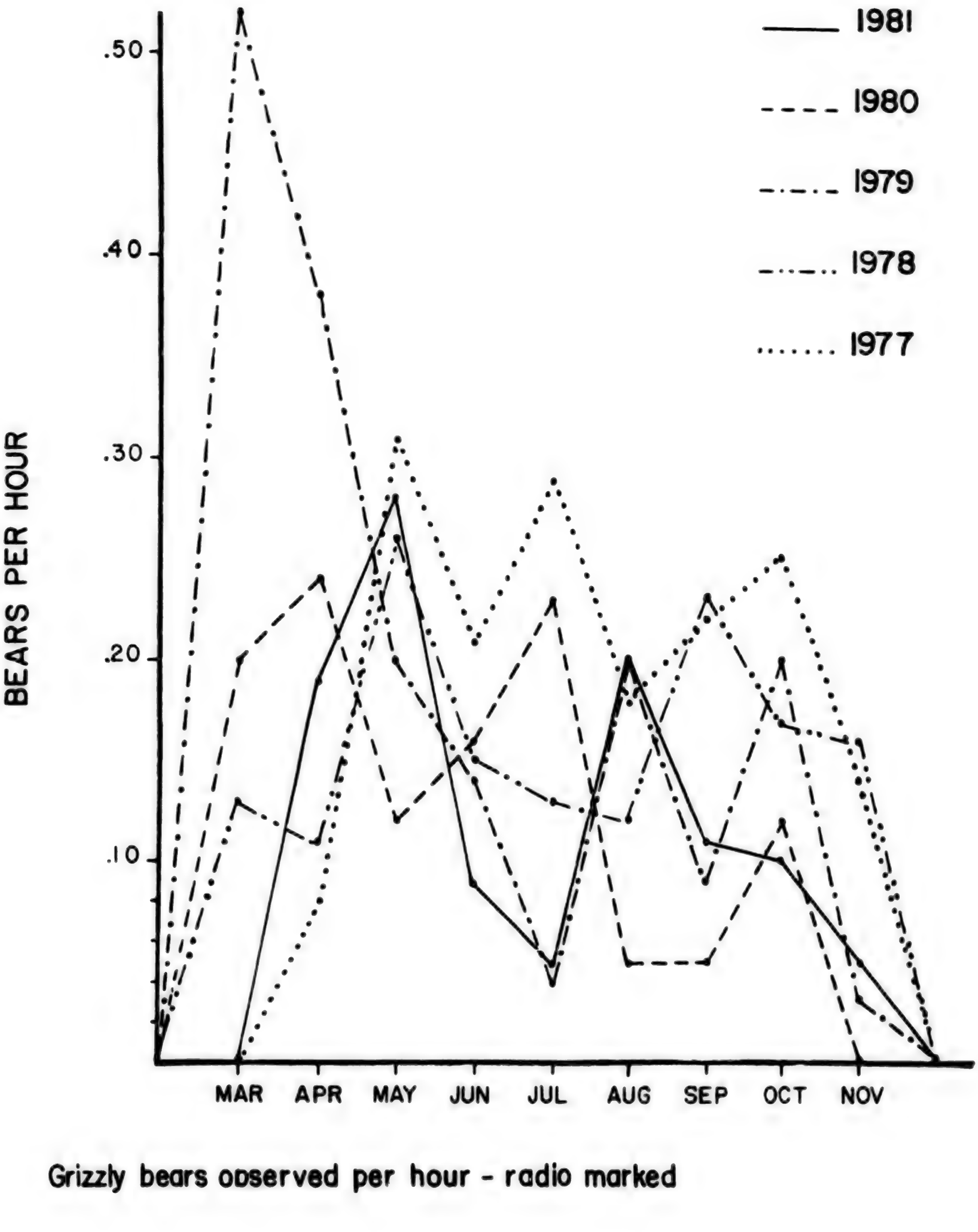

Fig. 10. Frequency of aerial observations of radio-marked grizzly bears.

FOOD HABITS

PROCEDURES

Yellowstone grizzly bear food habits were determined from scat analysis and ground investigation of feeding sites. Scats were collected whenever encountered during investigations of aerial relocations (relocation sites) of instrumented bears. The contents were assumed to be representative of the food habits of the bears in the study area.

All bear scats collected (grizzly, black, and species unknown) were included in the analysis.1/ Dried scats were soaked in water to soften them and washed through two screens. Coarse material was retained in the large screen (holes 0.125 in.) and fine material, including seeds, was collected in the small screen (holes 0.0328 in.). All items were identified to species when possible, and the percent volume of each item was visually estimated.

Procedures used in the ground investigation of feeding sites are described by Blanchard (1980) and Knight et al. (in prep.). Because feeding activities produce evidence of varying observability and longevity, site examinations were not used alone to determine food habits. Site examinations provide data on habitat use and preference and feeding behavior which produces long lasting sign. Easily digestible food items which are rarely revealed through scat analysis (such as mushrooms) are often evident at the feeding site. The more digestible items are probably under-represented in scat contents and, therefore, in the food habits analysis

Food item preference was determined using the comparison of usage and availability method described by Johnson (1980). The volume of items in scats indicated usage, and the frequency of items in scats indicated availability.

To quantify annual availability of carrion as a bear food, ungulate wintering areas in Yellowstone Park were searched for carcasses. The areas examined were Nez Perce and Rabbit Creeks, the Fountain Flats area, the Madison-Gibbon Rivers, lower Slough Creek and nearby Lamar River, and the Yellowstone River between Hellroaring Creek and the mouth of the Lamar River. When a carcass was located during a survey or relocation site examination, a mandible and femur were collected to determine the animal's age and physical condition at death. Marrow fat content ratings used were described by Cheatum (1949). Carcasses were examined for evidence that the animal was killed and/or fed on by bears. The date of death and distance to timber or open were estimated.

1/ Hair samples were collected from all day beds (N = 100) encountered during 1979. Analysis of the samples (Picton and Knight 1980) revealed 70% were from grizzly bear and 17% were from black bears. The remaining 12% were not from bear.

Whitebark pine *(Pinus albicaulis)* cone production was monitored to determine annual variation in the amount of pine nuts available to bears. Nine 90-m transects were established in whitebark pine stands in the study area (Fig. 11). Ten whitebark pine trees were selected along each transect and marked with a blaze and an aluminum identification tag. The crown of selected trees could be viewed from the ground from at least two angles. Cones were counted in July and early August when they had reached mature size, but few had been harvested by squirrels. All trunks joined at the base were considered one tree.

RESULTS AND DISCUSSION

Scat Analysis

In 1981, 220 scats were collected and analyzed for content (Table 5). Eighty percent of the scats were deposited in summer (June-August), and 16% and 4% were deposited in spring (March-May) and fall (September, October), respectively. Graminoids were consumed most frequently (76%) and in the greatest volumes (58%) in the spring (Table 6). Ants and mammals, primarily elk, were the second most important foods in spring. The most important summer foods were grasses/sedges and forbs. Graminoids occurred in 80% of the scats and comprised 34% of the scat volume. Forbs occurred in 75% of the scats and made up 38% of the scat volume. Fall scats primarily contained moose and grasses/sedges. Since only eight scats were collected in the fall, it is likely that the sample was not representative of the fall food habits.

Contents of scats collected from 1977 through 1981 were combined in Table 7. Sixty-two percent of the scats were deposited in summer. Eighteen percent and 20% of the scats were deposited in spring and fall, respectively. Smaller sample sizes during spring and fall result in underrepresentation of foods used during those seasons when combined with summer samples. Seasonal scat contents for 1977-81 are shown in Table 8. Carrion was the most important food in the spring (35% of the scat volume). Graminoids and pine nuts contributed 27% and 21% to the scat volumes. In summer, forbs, graminoids, and pine nuts each made up 20-30% of the scat volume. Pine nuts were the most important fall food. They occurred in 66% of the fall scats and made up 61% of the fall scat volume. Mammals and graminoids comprised 11% and 9% of the fall scat volume.

Food Item Preference

Food item preference was determined from scat analyses of 1973 through 1981. The annual 10 top natural food items are listed by percent of diet volume (use) and percent frequency of occurrence (availability) in Tables 9 and 10, respectively.

Comparisons of item use and availability rankings indicated the most consistently preferred foods were elk, pine nuts, yampa, claytonia, and dandelions (Table 11). Several items were preferred foods only during certain years: horsetail, thistle, biscuitroot, clover, fireweed, domestic stock, and huckleberries.

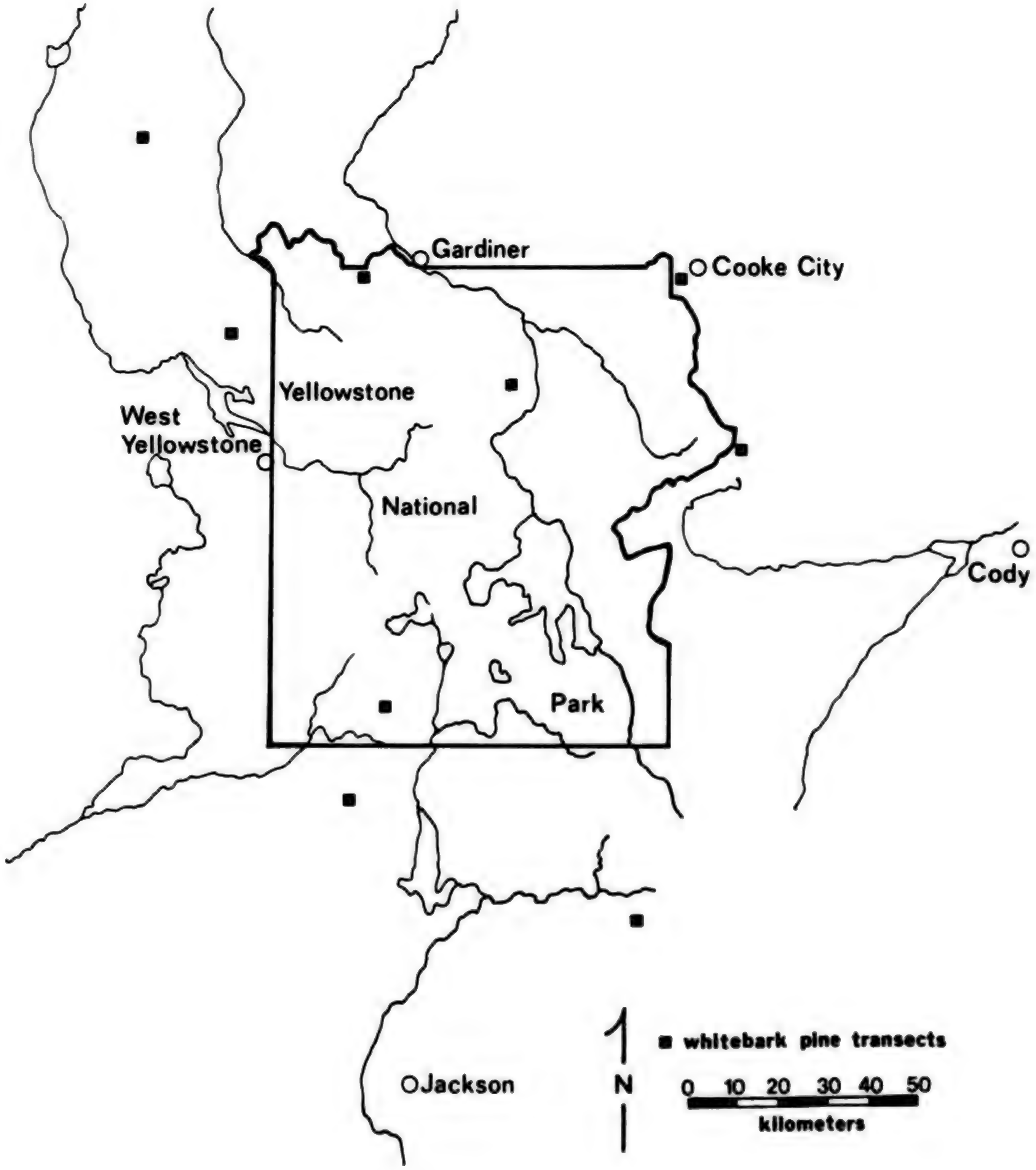

Fig. 11. Locations of whitebark pine cone production transects.

Table 5 . Bear scat content analysis, 1981 (N = 220)

Food item	No. scats	% Frequency occurrence	% Diet volume
Trees			
Pinus albicaulis (pine nuts)	22	10.0	5.5
Shrubs			
Crataegus douglasii	1	0.5	0.3
Ribes spp.	1	0.5	0.1
Shepherdia canadensis	6	2.7	0.7
Thamnus alniforia	1	0.5	0.1
Vaccinium scoparium	2	0.9	0.2
Vaccinium membranaceum	1	0.5	0.4
Total	8	3.6	1.8
Sporophytes			
Equisetum spp.	29	13.2	5.5
Grasses and grass-like plants			
Agrostis spp.	3	1.4	0.7
Bromus spp.	7	3.2	1.1
Calamagrostis spp.	2	0.9	0.3
Carex spp.	23	10.5	3.1
Festuca spp.	1	0.5	0.2
Grass/sedge	124	56.4	30.0
Juncus spp.	3	1.4	0.5
Melica spp.	2	0.9	0.2
Phleum alpinum	3	1.4	0.3
Poa spp.	31	14.1	3.2
Schizachne spp.	1	0.5	0.1
Total	171	77.7	36.6
Forbs			
Agoseris spp.	4	1.8	0.6
Arabis spp.	2	0.9	0.3
Claytonia lanceolata	1	0.5	0.1
Cirsium scariosum	8	3.6	2.3
Cirsium spp.	9	4.1	1.4
Epilobium angustifolium	3	1.4	0.3
Epilobium spp.	11	5.0	1.3
Forbs spp.	24	10.9	1.3
Fragaria spp.	1	0.5	0.1
Lomatium spp.	4	1.8	0.7
Mertensia spp.	3	1.4	0.2
Montia spp.	4	1.8	1.3
Perideridia gairdneri	3	1.4	0.9

Table 5 . Bear scat content analysis, 1981 (N = 220) (continued)

Food item	No. scats	% Frequency occurrence	% Diet volume
Forbs (continued)			
Perideridia spp.	1	0.5	0.0
Polygonum spp.	5	2.3	0.4
Ranunculus acriformis	1	0.5	0.3
Taraxacum ceratophorum	10	4.6	3.0
Taraxacum spp.	55	25.0	7.1
Tragopogon spp.	4	1.8	1.1
Trifolium spp.	43	19.6	7.6
Total	136	61.8	30.1
Mammals			
Bison	1	0.5	0.0
Black bear	2	0.9	0.9
Cattle	1	0.5	0.3
Deer	2	0.9	0.3
Elk	9	4.1	1.5
Ground squirrel *(Spermophilus citellus)*	1	0.5	0.5
Large mammal (unidentified)	6	2.7	0.6
Microtus spp.	2	0.9	0.3
Moose	4	1.8	1.0
Pocket gopher	1	0.5	0.1
Total	29	13.2	5.4
Insects			
Ants	68	30.9	3.9
Coleoptera spp.	1	0.5	0.0
Grasshopper	2	0.9	0.6
Total	70	31.8	4.5
Fish, Cutthroat trout	2	0.9	0.3
Birds (Unidentified)	1	0.5	0.0
Miscellaneous			
Debris	60	27.3	6.4
Dirt	9	4.1	0.8
Garbage	10	4.6	2.8
Pine needles	3	1.4	0.0
Rocks	1	0.5	0.0
Trap bait	4	1.8	0.3
Wood	2	0.9	0.0
Total	74	33.6	7.6

Table 6. Seasonal bear scat content analysis by major food categories, 1981

	Spring[1]			Summer[2]			Fall[3]		
	No. scats	% freq.	% vol.	No. scats	% freq.	% vol.	No. scats	% freq.	% vol.
Trees	1	3.0	1.5	16	9.9	4.9	0	-	-
Shrubs	1	3.0	1.2	6	3.7	1.6	0	-	-
Grasses/sedges	25	75.8	58.1	129	80.1	33.8	4	50.0	16.9
Forbs	5	15.2	5.5	121	75.2	37.8	2	25.0	1.0
Mammals	9	27.3	11.0	15	9.3	3.0	4	50.0	31.1
Insect	16	48.5	10.7	48	29.8	3.3	3	37.5	1.5
Total	33	(16%)		161	(80%)		8	(4%)	

[1] Spring = March, April, May
[2] Summer = June, July, August
[3] Fall = September, October

Table 7 . Bear scat content analysis, 1977-1981 (N = 3028)

Food item	No. scats	% Frequency occurrence	% Diet volume
Trees			
Abies lasiocarpa	1	0.0	0.0
Juniperus scopulorum	1	0.0	0.0
Pinus albicaulis	1028	34.0	28.7
Pinus contorta	3	0.1	0.0
Pinus spp.	7	0.2	0.2
Populus tremuloides	10	0.3	0.0
Total	1047	34.6	28.9
Shrubs			
Amelanchier alnifolia	2	0.1	0.0
Arctostaphylos uva-ursi	14	0.5	0.1
Berberis repens	2	0.1	0.0
Berberis spp.	4	0.1	0.0
Betula spp.	1	0.0	0.0
Cornus stolonifera	1	0.0	0.0
Crataegus douglasii	4	0.1	0.1
Crataegus spp.	3	0.1	0.0
Juniperus communis	1	0.0	0.0
Linnaea borealis	3	0.1	0.0
Lonicera spp.	6	0.2	0.0
Potentilla fruticose	1	0.0	0.0
Prunus virginiana	1	0.0	0.0
Purshia tridentata	4	0.1	0.0
Ribes spp	14	0.5	0.1
Rosa spp.	2	0.1	0.0
Rubus spp.	1	0.0	0.0
Salix spp.	1	0.0	0.0
Shepherdia canadensis	35	1.2	0.3
Shepherdia spp.	7	0.2	0.1
Sorbus scopulina	3	0.1	0.0
Symphoricarpos spp.	4	0.1	0.0
Vaccinium caespitosum	4	0.1	0.1
Vaccinium globulare	31	1.0	0.6
Vaccinium membranaceum	1	0.0	0.0
Vaccinium spp.	19	0.6	0.2
Total	242	8.0	3.2
Sporophytes, Bryophytes			
Algae	1	0.0	0.0
Equisetum arvense	10	0.3	0.2
Equisetum fluviatile	2	0.1	0.0
Equisetum spp.	250	8.3	2.9

Table 7 . Bear scat content analysis, 1977-1981 (N = 3028)
(continued)

Food item	No. scats	% Frequency occurrence	% Diet volume
Sporophytes, Bryophytes (continued)			
Moss	16	0.5	0.0
Mushroom	9	0.3	0.0
Puffballs	8	0.3	0.1
Total	293	9.7	3.3
Grasses and grass-like plants			
Agropyron spp.	12	0.4	0.1
Agrostis spp.	20	0.7	0.2
Avena sativa	1	0.0	0.0
Bromus anomalus	1	0.0	0.0
Bromus vulgaris	1	0.0	0.0
Bromus spp.	48	1.6	0.4
Calamagrostis spp.	12	0.4	0.1
Carex geyeri	2	0.1	0.0
Carex praticola	1	0.0	0.0
Carex raynoldsii	2	0.1	0.0
Carex spp.	269	8.9	2.4
Elymus spp.	4	0.1	0.0
Festuca idahoensis	1	0.0	0.0
Festuca spp.	4	0.1	0.0
Grass	259	8.6	2.4
Grass/sedge	763	25.2	13.2
Juncus spp.	6	0.2	0.1
Melica spectabilis	36	1.2	0.5
Melica spp.	33	1.1	0.4
Muhlenbergia spp.	1	0.0	0.0
Phleum alpinum	15	0.5	0.1
Poa pratensis	2	0.1	0.0
Poa spp.	200	6.6	1.9
Schizachne spp.	1	0.0	0.0
Scirpus spp.	4	0.1	0.0
Sporobolus spp.	1	0.0	0.0
Triticum spp.	1	0.0	0.0
Total	1468	48.5	22.1
Forbs			
Achillea millefolium	1	0.0	0.0
Achillea spp.	6	0.2	0.0
Agoseris spp.	4	0.1	0.1
Angelica spp.	1	0.0	0.0
Apiaceae	14	0.5	0.2

Table 7. Bear scat content analysis, 1977-1981 (N = 3028)
(continued)

Food item	No. scats	% Frequency occurrence	% Diet volume
Forbs (continued)			
Arabis spp.	5	0.2	0.0
Aster spp.	3	0.1	0.0
Asteraceae	8	0.3	0.1
Brassicaceae	2	0.1	0.0
Chrysopsis villosa	1	0.0	0.0
Cirsium arvense	9	0.3	0.1
Cirsium scariosum	59	2.0	0.8
Cirsium spp.	144	4.8	1.7
Claytonia lanceolata	130	4.3	1.5
Claytonia spp.	24	0.8	0.2
Epilobium angustifolium	67	2.2	0.6
Epilobium spp.	85	2.8	0.6
Erythronium grandiflorum	2	0.1	0.0
Fabaceae	2	0.1	0.0
Forb	162	5.4	0.9
Fragaria vesca	2	0.1	0.0
Fragaria virginiana	12	0.4	0.1
Fragaria vesca & virginiana	13	0.4	0.1
Galium spp.	1	0.0	0.0
Geranium spp.	4	0.1	0.0
Habenaria spp.	1	0.1	0.0
Helianthus spp.	3	0.1	0.0
Heracleum spp.	2	0.1	0.0
Heuchera cylindrica	1	0.0	0.0
Hydrophyllum capitatum	1	0.0	0.0
Hydrophyllum spp.	7	0.2	0.0
Hydrophyllaceae	2	0.1	0.0
Liatris spp.	1	0.0	0.0
Ligusticum spp.	2	0.1	0.1
Liliaceae	4	0.1	0.0
Linnaea borealis	2	0.1	0.0
Lomatium ambiguum	1	0.0	0.0
Lomatium cous	1	0.0	0.0
Lomatium dissectum	19	0.6	0.3
Lomatium triternatum	13	0.4	0.1
Lomatium spp.	150	5.0	1.7
Melilotus spp.	3	0.1	0.0
Mertensia ciliata	1	0.0	0.0
Mertensia spp.	11	0.4	0.1
Montia spp.	4	0.1	0.1
Orchidaceae	2	0.1	0.0
Penstemon wilcoxii	1	0.0	0.0
Penstemon spp.	1	0.0	0.0

Table 7 . Bear scat content analysis, 1977-1981 (N = 3028)
(continued)

Food item	No. scats	% Frequency occurrence	% Diet volume
Forbs (continued)			
Perideridia gairdneri	187	6.2	3.0
Perideridia spp.	2	0.1	0.1
Polygonum bistortoides	21	0.7	0.2
Polygonum douglasii & majus	3	0.1	0.0
Polygonum spp.	72	2.4	0.4
Potentilla spp.	5	0.2	0.0
Potomogeton spp.	18	0.6	0.3
Ranunculus acriformis	1	0.0	0.0
Ranunculus spp.	8	0.3	0.0
Ranunculaceae	3	0.1	0.0
Rubus spp.	1	0.0	0.0
Senecio spp.	1	0.0	0.0
Sonchus spp.	3	0.1	0.0
Streptopus amplexifolius	4	0.1	0.0
Taraxacum ceratophorum	24	0.8	0.4
Taraxacum officinale	15	0.5	0.2
Thalictrum occidentale	1	0.0	0.0
Thalictrum spp.	2	0.1	0.0
Thlaspi spp.	1	0.0	0.0
Tragopogon dubius	2	0.1	0.0
Tragopogon spp.	12	0.4	0.2
Trifolium repens	1	0.0	0.0
Trifolium longipes	1	0.0	0.0
Trifolium spp.	209	6.9	2.0
Xerophyllum tenax	1	0.0	0.0
Total	1207	40.0	20.1
Mammals			
Beaver	1	0.0	0.0
Bison	36	1.2	0.6
Black bear	6	0.2	0.1
Cattle	8	0.3	0.2
Cervidae	18	0.6	0.3
Deer	50	1.7	0.6
Elk	231	7.6	5.4
Eutamius minimus	1	0.0	0.0
Grizzly bear	12	0.4	0.2
Horse	1	0.0	0.0
Lagomorph	2	0.1	0.0
Large mammal (unidentified)	52	1.7	0.8
Marmot	3	0.1	0.0
Meat (unidentified)	12	0.4	0.2

Table 7. Bear scat content analysis, 1977-1981 (N = 3028) (continued)

Food item	No. scats	% Frequency occurrence	% Diet volume
Mammals (continued)			
Microtus spp.	28	0.9	0.3
Microtinae	9	0.3	0.1
Moose	23	0.8	0.4
Peromyscus spp.	1	0.0	0.0
Pocket gopher	27	0.9	0.4
Porcupine	4	0.1	0.1
Sheep (domestic)	3	0.1	0.0
Small mammal (unidentified)	6	0.2	0.0
Spermophilus citellus	2	0.1	0.0
Tamiasciurus spp.	4	0.1	0.1
Ursus spp.	1	0.0	0.0
Total	523	17.3	10.0
Insects			
Ants	676	22.3	4.3
Bees	9	0.3	0.0
Coleoptera	12	0.4	0.1
Grasshopper	31	1.0	0.6
Hymenoptera	1	0.0	0.0
Insect (unidentified)	1	0.0	0.0
Larva	2	0.1	0.0
Yespidae (wasp	1	0.0	0.0
Total	722	23.8	5.0
Fish, Cutthroat trout	41	1.4	0.6
Birds			
Birds (unidentified)	16	0.5	0.1
Duck	1	0.0	0.0
Grouse	3	0.1	0.0
Starling	1	0.0	0.0
Total	21	0.7	0.1
Garbage			
Cantaloup	2	0.1	0.0
Eggs	11	0.4	0.0
Garbage (unclassified)	56	1.9	1.1
Paper	2	0.1	0.0
Plastic	7	0.2	0.1
String	1	0.0	0.0
Tinfoil	2	0.1	0.0

Table 7. Bear scat content analysis, 1977-1981 (N = 3028) (continued)

Food item	No. scats	% Frequency occurrence	% Diet volume
Garbage (continued)			
Watermelon	1	0.0	0.0
Total	78	2.6	1.3
Miscellaneous			
Debris	343	11.3	4.8
Dirt	9	0.3	0.1
Mollusca	1	0.0	0.0
Pine needles	3	0.1	0.0
Rocks	1	0.0	0.0
Snail shells	6	0.0	0.0
Trap bait	33	1.1	0.6
Wood	6	0.2	0.1
Total	389	12.9	5.5

Table 8 . Seasonal bear scat content analysis by major food categories, 1977-1981

	Spring[1]			Summer[2]			Fall[3]		
	No. scats	% freq.	% vol.	No. scats	% freq.	% vol.	No. scats	% freq.	% vol.
Trees	96	23.1	21.1	410	28.7	22.1	296	66.2	60.8
Shrubs	10	2.4	1.3	141	9.9	3.6	38	8.5	4.8
Grasses/sedges	200	48.2	27.0	791	55.3	23.4	101	22.6	9.0
Forbs	98	23.6	7.4	736	51.4	27.1	51	11.4	5.8
Mammals	193	46.5	34.6	140	9.8	4.4	90	20.1	10.6
Insects	54	13.0	1.9	431	30.1	7.0	34	7.6	1.6
Total	415	(18%)		1,431	(62%)		447	(20%)	

[1] Spring = March, April, May
[2] Summer = June, July, August
[3] Fall = September, October, November

TABLE 9. MAJOR FOOD ITEMS OCCURRING IN SCATS BY YEAR AND BY PERCENT OF DIET VOLUME (USE)

	1981	1980	1979	1978	1977	1976	1975	1974-3
1	GRASS/SEDGE (37)	GRASS/SEDGE (23)	PINE NUTS (40)	GRASS/SEDGE (26)	GRASS/SEDGE (22)	PINE NUTS (45)	GRASS/SEDGE (31)	GRASS/SEDGE (36)
2	DANDELION (10)	ELK (17)	GRASS/SEDGE (19)	PINE NUTS (9)	ANTS (15)	GRASS/SEDGE (29)	TROUT (10)	CLAYTONIA (12)
3	CLOVER (8)	PINE NUTS (14)	HORSETAIL (3)	DANDELION (9)	HORSETAIL (7)	ANTS (10)	BISCUITROOT (7)	THISTLE (8)
4	HORSETAIL (6)	DANDELION (4)	YAMPA (3)	CLAYTONIA (4)	BISCUITROOT (6)	DOMESTIC STOCK (4)	THISTLE (7)	CLOVER (6)
5	PINE NUTS (6)	ANTS (4)	DANDELION (3)	BISCUITROOT (4)	YAMPA (6)	THISTLE (1)	ANTS (7)	ELK (4)
6	ANTS (4)	YAMPA (3)	ELK (3)	THISTLE (4)	ELK (5)	TROUT (1)	HORSETAIL (4)	ONION GRASS (4)
7	THISTLE (4)	CLAYTONIA (2)	CLOVER (2)	ANTS (4)	THISTLE (5)	HORSETAIL (1)	PINE NUTS (4)	PINE NUTS (3)
8	ELK (2)	CLOVER (2)	CLAYTONIA (2)	YAMPA (3)	BISON (3)		ONION GRASS (2)	HORSETAIL (3)
9	FIREWEED (2)	HORSETAIL (2)	THISTLE (2)	ELK (3)	KNOTWEED (2)		ANGELICA (2)	GROUSEBERRY (3)
10	MONTIA (1)	GROUSEBERRY (2)	BUCKTHORN (1)	HUCKLEBERRY (2)	PINE NUTS (2)		CLAYTONIA (1)	YAMPA (2)
TOTAL NATURAL ITEMS	59	88	106	93	108	11	27	

TABLE 10. MAJOR FOOD ITEMS OCCURRING IN SCATS BY YEAR AND BY PERCENT FREQUENCY OF OCCURRENCE (AVAILABILITY)

	1981	1980	1979	1978	1977	1976	1975	1974-3
1	GRASS/SEDGE (73)	GRASS/SEDGE (43)	GRASS/SEDGE (53)	GRASS/SEDGE (78)	GRASS/SEDGE (57)	GRASS/SEDGE (85)	GRASS/SEDGE (96)	GRASS/SEDGE (65)
2	ANTS (31)	ANTS (26)	PINE NUTS (47)	ANTS (29)	ANTS (39)	PINE NUTS (69)	TROUT (34)	THISTLE (16)
3	DANDELION (30)	ELK (20)	ANTS (13)	DANDELION (19)	BISCUITROOT (19)	ANTS (22)	ANTS (28)	CLAYTONIA (15)
4	CLOVER (20)	PINE NUTS (19)	HORSETAIL (11)	PINE NUTS (13)	HORSETAIL (17)	THISTLE (9)	THISTLE (18)	CLOVER (11)
5	HORSETAIL (13)	DANDELION (13)	DANDELION (9)	THISTLE (12)	THISTLE (17)	CLAYTONIA (4)	HORSETAIL (13)	TROUT (9)
6	PINE NUTS (10)	CLOVER (8)	CLAYTONIA (8)	BISCUITROOT (11)	YAMPA (11)	HORSETAIL (4)	BISCUITROOT (12)	ELK (7)
7	THISTLE (8)	YAMPA (6)	YAMPA (7)	CLAYTONIA (11)	KNOTWEED (5)	BISCUITROOT (4)	PINE NUTS (9)	POCKET GOPHER (6)
8	FIREWEED (6)	CLAYTONIA (6)	THISTLE (6)	HORSETAIL (8)	CLOVER (3)	BEES (4)	CLAYTONIA (7)	ONION GRASS (6)
9	ELK (4)	THISTLE (5)	ELK (6)	CLOVER (7)	FIREWEED (7)	TROUT (4)	BUTTERCUP (4)	HORSETAIL (6)
10	BUFFALOBERRY (3)	HORSETAIL (5)	CLOVER (5)	YAMPA (6)	ELK (6)	DOMESTIC STOCK (4)	ELK (3)	YAMPA (5)
TOTAL NATURAL ITEMS	59	88	106	93	108	11	27	-

Table 11. Preferred natural food items by year

	Very highly preferred	Highly preferred	Preferred
1981	Elk	Pine nuts, thistle, fireweed	Horsetail, clover, dandelions
1980	-	Yampa, horsetail	Pine nuts, elk, claytonia, dandelions
1979	Elk, clover, yampa, thistle	Claytonia, dandelions	Pine nuts, horsetail
1978	Yampa, claytonia, biscuitroot	Pine nuts, thistle	Dandelions
1977	Elk	-	Horsetail, yampa
1976	-	-	Pine nuts, domestic stock
1975	Pine nuts, biscuitroot	Claytonia	Thistle, horsetail
1974) 1973)	-	-	Horsetail, elk, claytonia, huckleberry

No preference was indicated for grasses, sedges, and ants. These items were apparently constant food items eaten in proportion to their availabilities.

Feed Site Exams

Ground examination of 73 bear relocation sites found feeding activity at 50 sites. The most common activity found in March and April was digging for forb and graminoid roots and gopher caches, and tearing logs for insects (Table 12). In May and June, digging for roots, tearing logs/anthills, and feeding on carcasses were the activities most often recorded. In July and August, no carcasses were found which bears had fed upon but roots and ants remained important. As in past years, feeding site examinations did not reveal all types of feeding activity which were indicated by scat contents (Knight et al. 1981). Grazed graminoids and forbs made up a large part of spring and summer scats, but evidence of grazing was found only twice.

Table 12. No. of major feeding activities recorded at 1981 feed site exams

	Mar-Apr	May-Jun	Jul-Aug	Sep	1981
Anthills torn		3	5		8
Carcass	1	3			4
Earthworms	1	1			2
Gopher dig	2	1	1		4
Grazing	1	1			2
Logs torn	2	5	5	1	13
Rocks turned			2		2
Root dig	3	8	8		19
Squirrel cache		2	2		4
Tree stripped		1			1
Unknown dig	2	2	5	1	10

Examination of feeding sites often allows discovery of scats and yields information on habitat use by bears. Sixty-six percent of the sites were in timber, 23% occurred in grass/forb meadows, and 11% occurred in meadows dominated by sagebrush. The bears usually fed near a timber-open edge. Sixty-two percent of the sites were less than 30 m from an edge, 29% of the sites were 30-100 m from a timber-open edge, and 7% were more than 100 m from an edge.

Thirteen ungulate carcasses were found at feeding sites in 1981: six elk *(Cervus elaphus)*, three bison *(Bison bison)*, three moose *(Alces alces)*, and one mule deer *(Odocoileus hemionus)*. Of the 10 carcasses which were fed on by bears, three were probably killed by bears and the cause of death for the remaining seven animals was unknown. It could not be determined if bears had killed or fed upon three of the carcasses. Eleven carcasses were found in the timber and two in the open. Most of the animals were subadults: three calves, two yearlings, one 2-year-old, and two adults. Of five carcasses for which sex could be determined, four were males. Examination of femur marrow from seven carcasses indicated the animals were in good condition (>70% fat content) when they died; one elk was in poor condition.

Carcass Surveys, 1980 and 1981

Two areas with historical concentrations of winter-killed ungulate carcasses were searched in April and May 1980/1981 to form an index of carcasses available to bears coming out of hibernation. In 1980, two elk carcasses were found along the Yellowstone River between Blacktail Deer Creek and the Lamar River; and in 1981, three bison carcasses were found in the Nez Perce Creek/Firehole flats area. The winters of 1979-80 and 1980-81 had relatively mild temperatures and snowfall, and consequently ungulate winter-kill was slight. More carcasses should be expected following harsher winters. More than 100 dead elk were counted along the Yellowstone River survey route during 1975 compared to no dead elk in 1981.

Whitebark Pine Production

Whitebark pine cones were counted at nine locations from 20 July - 7 August 1980 and 13 July - 13 August 1981 (Table 13). Mean cone production per tree was higher in 1980 than 1981 ($\underline{P} < 0.0001$, Paired t). Transect I on the Targhee National Forest was located in a stand which was infested with mountain pine beetle *(Dendroctonus ponderosae)*. Beetles, larvae, and blue stain were observed in many trees, including transect trees Nos. 4, 6, and 7. This transect will continue to be monitored to document cone production in beetle-infested trees.

Use of Ants

Ants were collected from 1979 through 1981 for species identification at sites where bears appeared to have been feeding on ants (torn logs and anthills, turned rocks) and from scats. Nineteen ant species were found at feeding sites, and nine ant species were identified in scat contents (Table 14). It was likely that more ant species were present in scats, but most ants found in scats were unidentifiable fragments. Table 14 also indicates the wide variety of places ant species were likely to form nests.

Bears appeared to have fed on ants at 101 sites, but ants were found at only 38 of these sites. It is possible that after the ants were disturbed, the colony died or relocated (Wheeler and Wheeler, unpublished report). This may explain why ants were not found at many of the feeding sites and why two ant species found in scats were not found at feeding site examinations.

Ant species vary in size of body and colonies. Presumably, larger ants and ant colonies would be most attractive for bears to feed on. Of the 19 ant species found at bear feeding sites, 17 species were found at four or fewer sites. *Camponotus modoc* and *Formica neorufibarbis* were found at 12 and 9 sites, respectively. While information on size and abundance of ants and ant colonies is incomplete, the available information is interesting. *Camponotus* spp. are the largest and most common ants found in the study area. *Camponotus* workers range from 6 to 13 mm. They form abundant, populous colonies. *Formica* spp. are medium-sized ants (workers, 3-9 mm) for which colony size was not available except for two species. *F. altipetens* and *F. subsericea* both may have populous colonies. *F. subnuda* makes slaves of *F. argentea*, *F. fusca*, and *F. neorufibarbis*, so these species may have been eaten when bears raided *F. subnuda* nests. *Acanthomyops* spp. workers are small (2.3 - 4 mm). *Lasius* spp. are also small (workers 2-4 mm) but may have very populous colonies. *Leptothorax* spp. workers are small (1.5 - 4 mm) and form small colonies. *Myrmicee* spp.

Table 13. Number of cones in 10 whitebark pine trees at nine locations, 1980 and 1981

Transect	Tree										Mean cones/tree
	1	2	3	4	5	6	7	8	9	10	
A	0[1]	10	47	2	7	4	14	38	25	80	23
	12[2]	36	11	1	6	0	24	23	27	138	28
B	20	25	10	34	35	26	31	6	20	28	24
	17	0	2	27	10	16	0	7	8	0	9
C	7	8	23	6	23	20	0	8	4	40	14
	4	0	13	3	5	6	4	11	2	6	5
D	18	19	19	5	12	6	19	8	6	32	14
	12	10	14	6	15	11	5	5	4	7	9
E	32	26	21	16	28	14	6	18	16	14	19
	0	0	0	2	0	0	3	0	3	0	1
F	25	11	51	50	51	169	20	60	65	60	56
	0	0	5	0	0	0	5	3	1	0	1
G	35	8	50	52	12	90	53	5	28	18	35
	3	1	5	50	18	20	22	3	22	0	14
H	30	25	9	24	30	13	18	28	47	24	25
	45	24	18	99	36	50	60	45	100	12	49
I	42	11	0	18	12	26	14	11	65	16	22
	4	1	0	2	0	0	1	5	15	0	3
Total											26
											13

[1] 1980
[2] 1981

Table 14. Ant species found at grizzly bear feeding sites and in bear scats, 1979-1981

Ant species	Nest sites
Acanthomyops spp. ^{F}	Usually in soil under stones, logs/in rotten wood
Camponotus spp.	Usually in dead wood
C. herculeanus ^{FS}	In logs, stumps, snags, esp. conifers
C. modoc ^{FS}	In rotten wood
C. vicinus ^{FS}	Usually under stones; some in exposed soil
Formica spp. ^{FS}	
F. altipetens ^{F}	Usually in soil; form mounds in meadows
F. argentea ^{F}	Usually under stones
F. fusca ^{F}	Usually in soil under stones or logs, some in exposed soil
F. haemorrhoidalis ^{F}	Usually under stones or plants in grasslands; prefer sagebrush
F. hewitti ^{F}	Usually under stones, logs
F. neorufibarbis ^{FS}	Under stones; in or under rotten wood; in soil by stumps
F. occulta ^{F}	Usually in exposed soil
F. opaciventris ^{F}	Large clustered mounds in coniferous forests
F. oreas ^{FS}	Under stones, in and under wood in wooded areas, sagebrush or grasslands
F. subnuda ^{S}	In and under rotten wood; in base of tree
F. subsericea ^{F}	Usually under stones, some under dead and rotten wood, or in exposed soil
F. ulkei ^{F}	
F. whymperi ^{FS}	
Lasius spp.	
L. sitkaensis ^{FS}	Under stones and wood
Leptothorax spp.	In dead and rotten wood; in exposed soil; in insect galls; in nests of other ant species
L. provancheri ^{F}	
Myrmica spp.	In soil under stones or rotten wood
M. brevinodes ^{S}	Under stones
M. lobifrons ^{F}	Under stones, branches, cow manure

F = ants found at feed sites.
S = ants found in scats.

are slow-moving, medium-sized workers (4 - 5.5 mm) and form medium-sized colonies. Winged sexual forms of all species are larger than workers and can be produced in vast numbers in mature colonies. Ant size and abundance information, however, seems to indicate that bears ate any ant no matter what its body or colony size.

Bears usually found ants in logs (61%) and anthills (24%). The remaining 15% of the ant feeding sites were turned rocks, clawed stumps and snags, and diggings in the dirt. Seventy percent of the sites occurred in the timber, and 30% were located in meadows of grass/forb, sagebrush, and willow.

Sixty-six percent of the feeding sites where bears fed on ants occurred during June through August. This period coincides with the production of ant brood and winged sexual forms for the study area (Wheeler and Wheeler, unpubl. report). While worker ants are mostly exoskeleton, winged females are larger, the thorax enlarged with flight muscles, and the swollen gaster contains fat and/or eggs. Ant young (eggs, larvae and pupae) are usually concentrated in brood chambers near the surface of the mound as are seeds stored by harvesting ants (Wheeler and Wheeler, unpubl. report). The increase in nutrients available in an ant nest from June-August probably prompts the bears to increase ant digging activity.

The amount of ants in scats varied widely from 1973 to 1981 (Table 15). The percent frequency of occurrence ranged from 0.4% to 30.9%, and the percent of scat volume ranged from 0.5 to 15.1%. Although ants do not appear to be a highly important item in grizzly bear diets, they are evidently a constantly available bear food which may be consumed in large quantities in some years.

Summary

The results from scat analyses, feeding site examinations, carcass surveys, and whitebark pine cone production transects can be combined to give a more complete picture of grizzly bear food habits than any of the methods alone. Scat analysis provides information about most of the foods eaten by bears and probably does a good job of describing their diet. It is probable, however, that the amount of highly digestible items eaten is underestimated and that the percent of items of low digestibility may be overestimated. Feeding site examinations help to increase the number of scats collected and give information on some of the types of areas used by bears while feeding. Carcass and whitebark pine cone surveys help predict the availability of these two important food sources. It is hoped that a long range monitoring system which includes these elements may be useful in predicting years when grizzly bears are hungry and are more likely to frequent areas of human habitation such as campgrounds and hunting camps.

Table 15. Annual occurrence and volume of ants in bear scats, 1973-1981

	1973	1974	1975	1976	1977	1978	1979	1980	1981	Total[1]
% Frequency occurrence	13.4	6.9	28.0	22.0	0.4	29.0	12.6	25.6	30.9	22.3
% Scat volume	0.5	1.0	6.8	9.5	15.1	3.6	1.0	4.0	3.9	4.3
Total No. scats	179	436	68	23	474	549	749	527	220	3,028

[1] Total is for 1977-1981 only.

POPULATION PARAMETERS

FEMALES WITH YOUNG

During 1981 the IGBT monitored 13 unduplicated females with young. Female grizzly bears produce cubs approximately every 3 years. Inspection of Fig. 12 shows that the females breeding in 1975, 1978, and 1981 are exhibiting an upward trend in contrast to those breeding in 1974, 1977, and 1980 and those breeding in 1976 and 1979. This trend may be reversed by 1984 since there were three known female mortalities in 1981 and possibly as many as six.

PRODUCTION

The female reproductive rate is the number of young produced per breeding female per year. A mean for the population can be obtained by dividing the number of cubs produced by total reproductive years or dividing cubs produced each litter by number of years to the next litter and averaging. On an annual basis, reproductive rate can be estimated by dividing mean litter size by the mean reproductive cycle. Given an adequate sample, the results from all these methods should be the same.

By 1979 we had a sample size of seven reproductive cycles for six females to calculate a reproductive rate of 0.555. By 1980 we had a sample size of 10 cycles for eight marked females to calculate a reproductive rate of 0.810. One new cycle was added during 1981, and those of two other females were found to have lengthened, giving a mean cycle length of 3.09 and a mean reproductive rate of 0.558. Sample sizes are still too small to make confident estimates of the population reproductive rate. The 1980 reproductive rate was probably abnormally high due to an exceptionally good food year in 1979 and because there were two females that lost litters and exhibited 1-year cycles.

Ratios of young:female in 1981 (Table 16) were the lowest since 1975. This may have been partially due to a poor-to-mediocre food year in 1980 and a very poor food supply in the spring of 1981.

Age of reproductive senescence appears to be quite variable. Two females died that had been tagged for several years. Bear 12 died at the age of 25 of natural causes. She had produced two cubs at the age of 21, one cub which was lost in 1980 and another cub that was lost in 1981. Bear 26 produced at least one cub in 1976 at the age of 17 and was shot in 1981 without producing another litter that survived to early summer. Bear 8 produced two cubs in 1981 at age 15, and Bear 28 produced two cubs in 1977 at age 16. Bear 13, on the other hand, is 12 and apparently has not produced a successful litter since age 7.

SEX AND AGE STRUCTURE

Since 1975 we have radio-instrumented 81 different grizzly bears. An additional eight have been trapped, ear tagged, and released; and

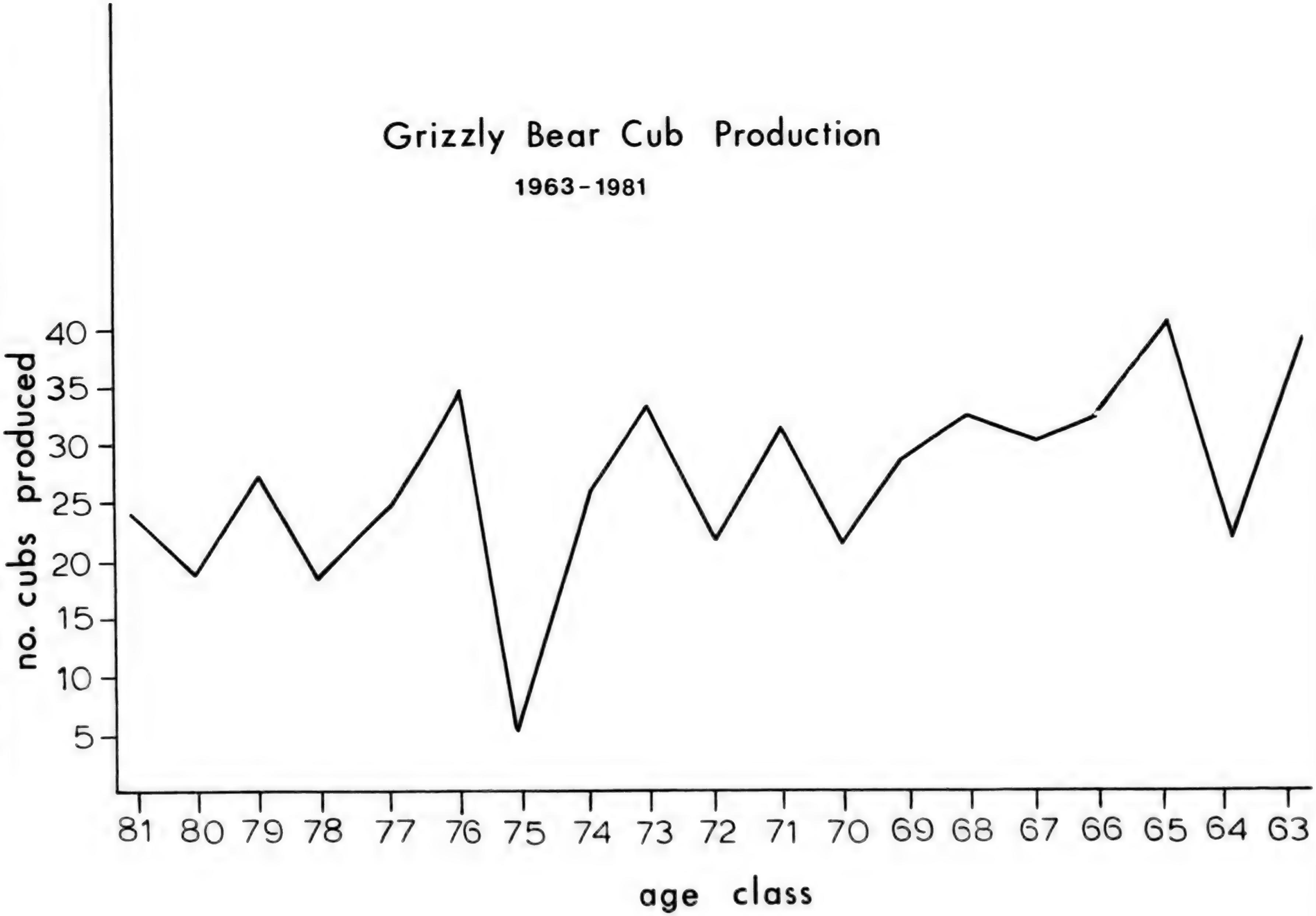

Fig. 12. Annual unduplicated observations of cubs, 1963-81.

24 cubs and yearlings have been associated with trapped females but not tagged. Seventy-four of these bears were believed to be alive during 1981. From these, we have constructed an age structure as illustrated in Fig. 13.

Although the age structure looks better than that illustrated in the 1980 report, it is still young with an adult:subadult ratio of 35:65. This is still characteristic of a population that has been and still is heavily exploited.

Sex ratios for adult bears were 58M:42F, compared to 62M:38F in the 1980 sample. Ratios for subadults were 57M:43F, compared to 62M:38F in the 1980 sample. Although this year's ratios are an improvement, there is still an abnormal abundance of males in the sample. The sex ratio for 21 cubs handled since 1976 was 67M:33F.

SURVIVORSHIP

Survivorship by age class is illustrated in Table 17 and Fig. 14. Although the sample was not large enough to warrant breaking into sex classes, it still drops off more sharply than that of Craighead (1974) for either sex. The survival rate of prime breeding adults from ages 6 to 12 averages 94%, which is probably just marginal for maintaining the population. If adult females alone were considered, the mortality curve would probably drop below the point needed to maintain the population since the sex ratio of 33 dead adults whose sex and age were known since 1974 is 39M:61F. In 1980 it was evident that adult females were dying at a faster rate than adult males. This trend was more evident in 1981.

Survival of yearlings may be abnormally low. Three of the nine known yearling mortalities had been abandoned as cubs and four were weaned as yearlings. Although early weaning shortens the reproductive cycle, it is probably not advantageous in the Yellowstone ecosystem.

MORTALITY

Grizzly bear mortalities for 1981 are summarized in Table 18. Known mortalities were those where a carcass was recovered. Probable mortalities were those where there was good reason to believe that the bear had died but the carcass was not recovered. In the case of radioed bears, sudden failure of a transmitter near known human habitation was considered a probable cause. Possible deaths were those where a mortality was reported but with no other verification. Since 1981 was a high mortality year, mortalities in the female segment probably exceeded that which the population can withstand.

POPULATION ESTIMATION

We chose adult females as the population segment for which we had the best sex and age information to make a point estimate of the population size. During 1979, 1980, and 1981 we observed, 14, 9, and 13 females with

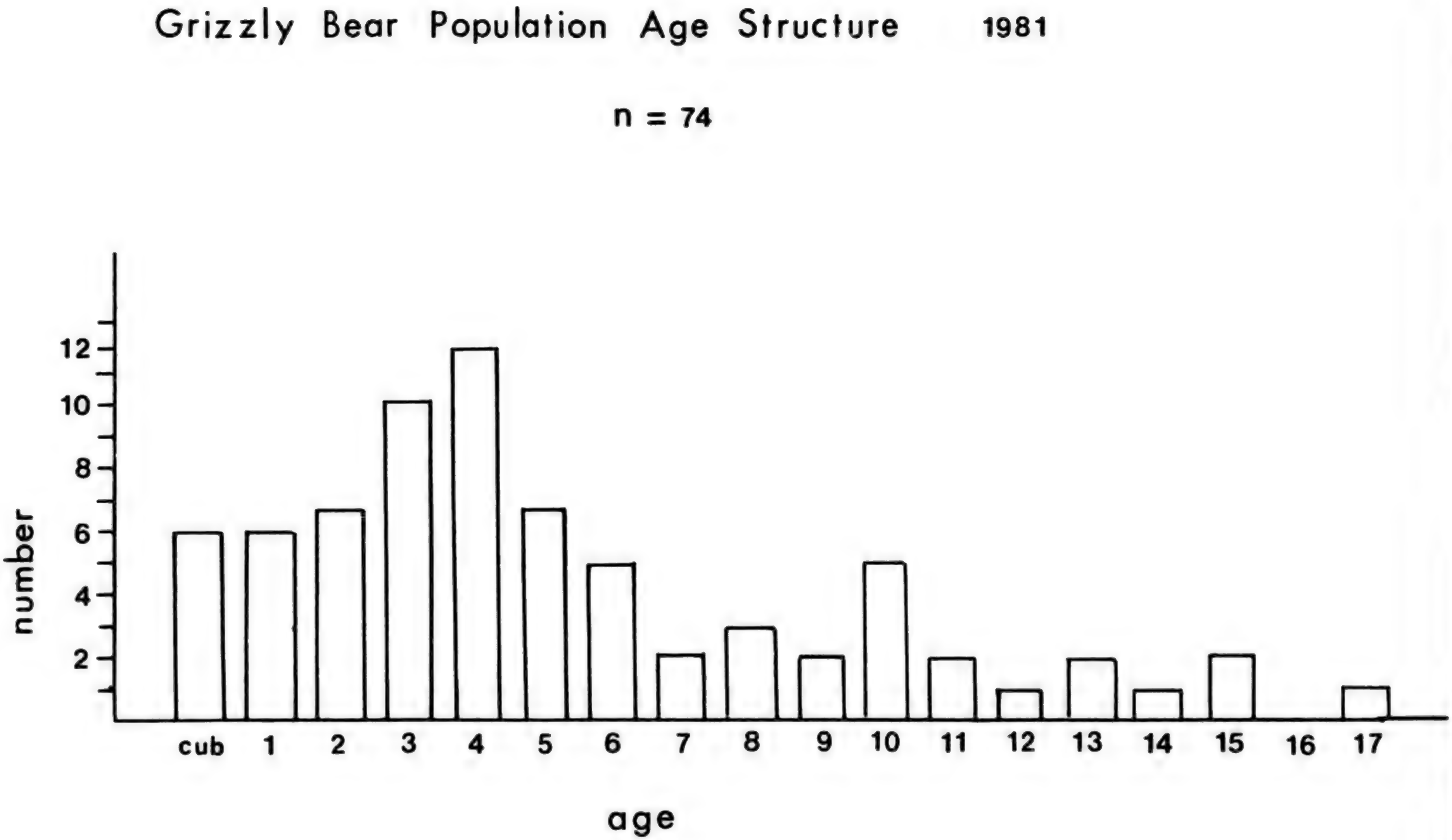

Fig. 13. Grizzly bear population age structure during 1981.

Table 16. Grizzly bear females with cubs, 1974-81

Year	Females	Cubs	Ratio	
1974	21	36	1.7	cumulative
	15	26	1.7	unduplicated
1975	5	8	1.6	
	4	6	1.5	
1976	36	69	1.9	
	17	35	2.0	
1977	24	43	1.8	
	13	25	1.9	
1978	15	31	2.1	
	10	19	1.9	
1979	21	39	1.9	
	13	26	2.0	
1980	13	26	2.0	
	9	19	2.1	
1981	17	32	1.9	
	13	22	1.7	
Avg.	11.75	22.25	1.89	

Table 17. Grizzly bear survivorship by age class

Age	% Surviving to next year class	Sample size
Cub	89	44
1	70	30
2	60	15
3	77	13
4	100	12
5	75	12
6	100	10
7	100	12
8	91	11
9	89	9
10	90	10
11	100	6
12	80	5

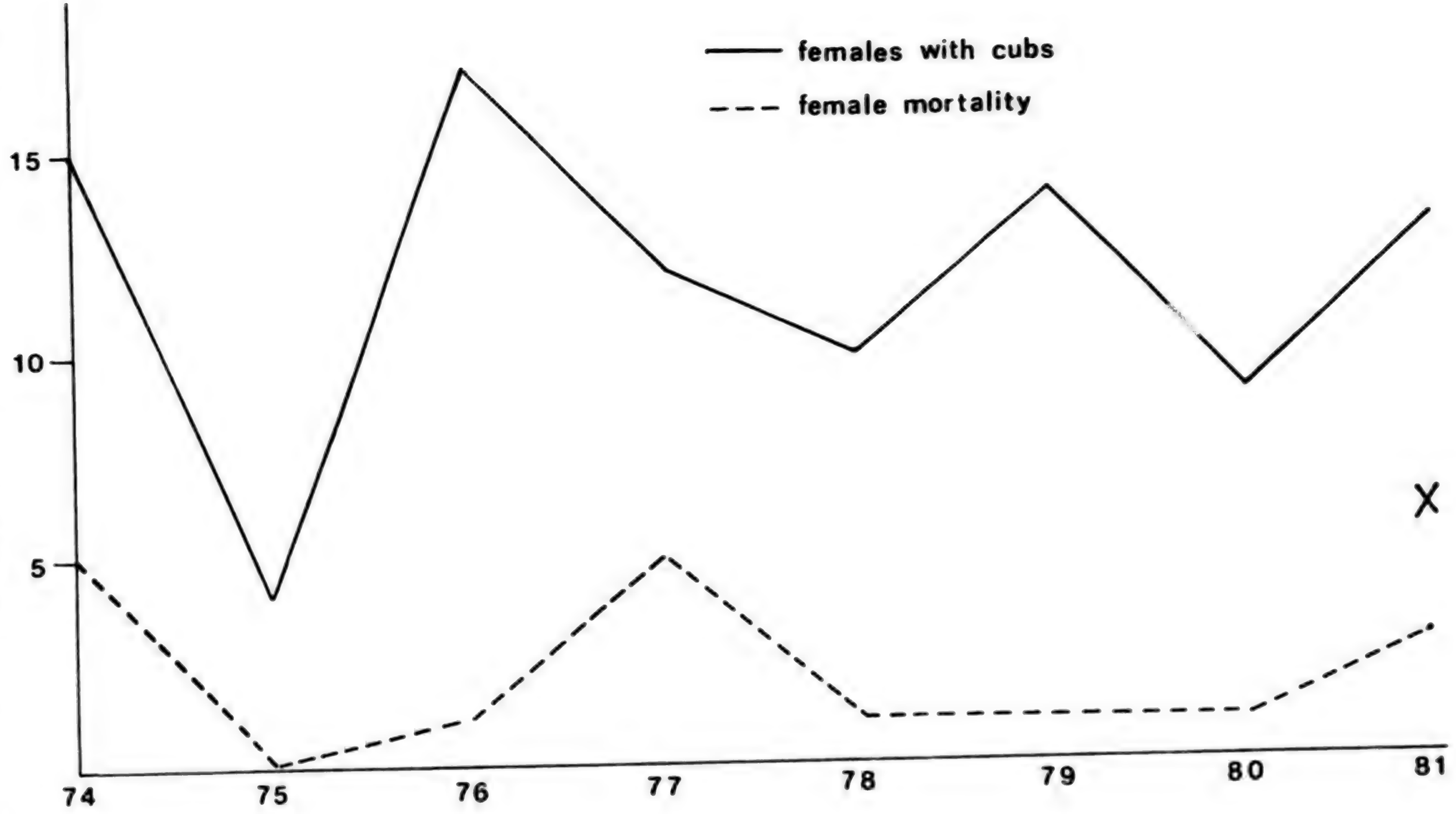

Fig. 14. Annual unduplicated observations and mortalities of female grizzly bears.

Table 18. Grizzly bear mortalities, 1981

	Location	Total
Known		
Natural		
Adult female, #12	Yellowstone Lake	
Cub of above	Yellowstone Lake	2
Man-caused		
Adult female	Eagle Creek	
Adult female, #26	Gardiner	
Adult male, #22	Camp Monaco	
Adult male, #46	Cooke City	
Subadult male	Hilgard	
Subadult male, #49	Thorofare	6
Probable		
Man-caused		
Adult female, #68	Thorofare	
Adult female, #10	Cooke City	
Yearling female, #75	Gardiner	
Subadult male, #62	Thorofare	
Unknown sex and age	Centennial	5
Possible		
Man-caused		
Unknown sex and age	Lucky Dog Road, Idaho	
Adult male, #5	Slough Creek	
Adult female	Thorofare	
Unknown sex, cub of above	Thorofare	4
	TOTAL . . .	17

* * * * * * * * * * *

Adult female	6
Subadult female	1
Total female	7
Adult male	3
Subadult male	3
Total male	6
Unknown sex	4

* * * * * * * * * * *

	Known	Probable	Possible	Total
Natural	2	0	0	2
Control action	0	0	0	0
Hunter/outfitter	4	2	3	9
Other	2	3	1	6
				17

cubs, respectively. During this time, seven of these died, leaving at least 29 adult females in the population, assuming a breeding interval of about 3 years. We also assumed, for the purpose of this estimate, that any unknown natural mortality was compensated for by recruitment.

Using 29 adult females as a basis for calculation and applying the observed adult sex ratio of 58M:42F, we can estimate that we have 40 adult males in the population. This gives us a total of 69 adults. Using the observed ratio of adults to subadults of 35:65, we can estimate a total of 168 subadults. This gives us a total of 197 bears in the population.

We wish to emphasize that this is a point estimate based on some small sample sizes, and we are unable to assess its accuracy at this time.

CONFLICTS WITH MAN

The year 1981 will be remembered for the unusually high frequency of human encounters with grizzly bears. These incidents occurred throughout the year and throughout the study area.

Grizzly bears were first reported near cabins and campgrounds in early April on the Shoshone National Forest (SNF), Wyoming. These incidents continued regularly throughout the spring and summer. Encounters with grizzlies on the Bridger-Teton National Forest (BTNF) were first reported in July and also continued through the summer. Conflicts escalated on both forests with the onset of hunting season and occupation of hunting camps. Sixty-eight different incidents were recorded by the forests, representing only a fraction of the total number of incidents rumored or reported indirectly.

Problems with grizzlies in Montana were largely associated with campgrounds, private residences, and the towns of West Yellowstone, Cooke City, Silver Gate, and Cooke Pass. Conflicts began in July and continued regularly until the tourist season ended in September. There was not an escalation in problems during hunting season in Montana, although encounters continued at a level higher than previous years.

Seven encounters with grizzlies resulted in attacks by the bear. Two hikers on separate occasions were treed by grizzlies in Sunlight Creek and Trail Creek, SNF. One hunter was attacked and mauled by a lone grizzly in Little Sunlight Cr, SNF. A hunter was charged by a female grizzly with a cub, and one person was bitten on the hand through a tent by a bear of unknown species on the BTNF. Two people in separate incidents were charged by females with cubs in Eagle Creek and near Dome Mountain on the Gallatin National Forest (GNF). One of these people was mauled. One person was attacked and mauled by a female with cubs in the Firehole area of Yellowstone Park.

As many as 17 grizzly bears died in 1981 (Table 18). Two were natural deaths, and the others were man-caused. Of the 15 man-caused mortalities, 9 were by hunters and outfitters.

In response to complaints and in an attempt to prevent mortality of grizzlies, management agencies trapped 23 grizzly bears and moved them 33 times to different locations (Table 19).

Nearly all the problems associated with grizzly bears during 1981 were related to the availability of human food and garbage. The exceptions were seven encounters resulting in an attack or charge, which were caused by people surprising bears at too close a distance. The grizzlies frequenting private residences around Gardiner were seeking apples from orchards. The leading attractants that brought grizzlies into contact with people were human garbage, groceries, cooking and persistent food smells, game meat, and horse feed. Problems were more persistent at camps and residences that were more heavily and consistently used by

Table 19. Grizzly bears trapped and relocated in management actions, 1981

Bear (No.)	Trap date	Trap location*	Relocation site	Trapper
SAd male (62)	May 20	Shoshone Lodge, SNF	Sunlight Basin, SNF	IGBT/WY
SAd female (69)	Jul 30	Crandall, SNF	Lodgepole Cr, SNF	IGBT/WY
SAd male (62)	Sep 02	Pahaska Tepee, SNF	Younts Cr, BTNF	IGBT/WY
SAd male (73)	Sep 12	Little Bear Lk, SNF	Lodgepole Cr, SNF	IGBT/WY
Adult		Parade Rest Ranch, MT	Tepee Cr, GNF	MT
Cub male (74)	Aug 13	Cooke City, MT	Saddle Mtn, YNP	YNP/MT
Cub female (67)	Aug 13	Cooke City, MT	Saddle Mtn, YNP	YNP/MT
Ad female (8)	Aug 13	Cooke City, MT	Saddle Mtn, YNP	YNP/MT
SAd female (60)	Aug 14	Cooke City, MT	Cooke Pk, YNP	YNP/MT
Ad male (5)	Aug 16	Cooke City, MT	The Crags, YNP	YNP/MT
SAd female (69)	Aug 18	Cooke City, MT	The Crags, YNP	YNP/MT
SAd male (G12)	Aug 18	Cooke City, MT	The Crags, YNP	YNP/MT
Cub male (74)	Sep 01	Cooke City, MT	Surprise Cr, YNP	YNP/MT
Cub female (67)	Sep 01	Cooke City, MT	Surprise Cr, YNP	YNP/MT
Ad female (8)	Sep 01	Cooke City, MT	Surprise Cr, YNP	YNP/MT
Ad female (26)	Sep 23	Mikolich res., MT	Blacktail Cr, YNP	YNP/MT
SAd female (75)	Sep 24	Mikolich res., MT	Blacktail Cr, YNP	YNP/MT
SAd female (76)	Sep 25	Mikolich res., MT	Blacktail Cr, YNP	YNP/MT
Ad female (77)	Sep 27	Mikolich res., MT	Blacktail Cr, YNP	YNP/MT
Ad female (26)	Oct 06	Mikolich res., MT	Arnica Cr, YNP	YNP/MT
SAd male (78)	Oct 07	Mikolich res., MT	Grebe Lk, YNP	YNP/MT
Ad female (79)	Oct 14	Blanding R.S., GNF	Grebe Lk, YNP	YNP/MT
SAd male (80)	Oct 14	Blanding R.S., GNF	Grebe Lk, YNP	YNP/MT
SAd male (71)	Oct 26	Blanding R.S., GNF	Snake R., YNP	YNP/MT
Ad male (5)	Aug 31	Slough Cr, GNF	Red Cr, SNF	MT
SAd female (59)	Aug 12	Canyon, YNP	Death Ridge, YNP	YNP
Cub male (74)	Sep 13	Grant Village, YNP	Mirror Plateau, YNP	YNP
SAd male (81)	Oct 05	Lake, YNP	Blacktail Plateau, YNP	YNP
Ad female (50)	Oct 12	W Entrance, YNP	Turbid Lk, YNP	YNP
SAd male (81)	Oct 17	Lake, YNP	Divide Lk, YNP	YNP
Ad female (82)	Oct 21	Lake, YNP	Rose Cr, YNP	YNP
Ad female (83)	Oct 23	Lake, YNP	Rose Cr, YNP	YNP
Ad female (83)	Oct 31	Lake, YNP	Glen Cr, YNP	YNP

* SNF = Shoshone National Forest; BTNF = Bridger-Teton National Forest; GNF = Gallatin National Forest; YNP = Yellowstone National Park.

people. Many individual bears were involved, not just a few "human-conditioned" bears. In general, the bears fled from humans and damaged camps when no one was present.

The reason grizzly bears were observed so frequently around human habitations this year was a shortage of natural foods. The food shortage began in the fall of 1980 when the crop of whitebark pine nuts was mediocre to poor throughout the study area. The winter of 1980-81 was very mild with little snow cover. Snow depths during April and May averaged 19 inches less than the 15-year averages at various snow survey stations within the study area. This resulted in virtually no ungulate winterkill. Grizzlies were observed on carcasses only three times during aerial flights from March through May. Carcass surveys along the Yellowstone River in northern Yellowstone Park and the Firehole River and Nez Perce Creek in west-central Yellowstone Park revealed no dead elk. (See Food Habits section.)

Grizzly bears trapped during May and June were all thin and in poor condition. Two radio-collared adult females that should have come out of their dens with cubs were observed alone. At least two yearlings were believed to have died during the spring from malnutrition. One adult female died from a combination of old age and malnutrition.

During July and August, rainfall averaged 1 to 1-1/2 inches less than normal. Vegetation dessicated. Bears were still thin by August when fat deposits should have started accumulating for denning.

Pine nuts usually become available to bears in late August. Unfortunately, the 1981 nut crop was virtually a failure throughout the study area. Transects in whitebark pine stands were run in July. The counts were significantly less than those of 1980. (See Food Habits section.)

The result was that bears sought food from people. They were rewarded when food was easily obtained, and they stayed where they found food. They often returned repeatedly to these sources when trapped and moved to other locations.

The Yellowstone grizzly bear population can be expected to fluctuate with the availability of food. Natural food availability is dependent on weather, which is largely unpredictable. Years of shortages such as 1981 can be predicted with the use of food availability indices: spring ungulate carcass surveys and whitebark pine production transects. Appropriate management actions can be taken to prevent the high frequency of human/grizzly encounters as occurred in 1981 and thereby decrease the number of man-caused mortalities.

HABITAT PREFERENCE

PROCEDURES

Preliminary analysis of habitat preference by grizzly bears was begun in 1981. Discriminant function analysis was used to statistically distinguish between habitats that bears use and habitats they apparently do not use.

Selected areas within the home ranges of one or more grizzly bears were mapped to the plant community level on aerial color photographs (scale 1:24,000). Community determination and analysis are discussed by Knight et al. (in prep.). Each community was recorded in the same format used to record bear activity and feeding sites. (See Food Habits section.)

Aerial relocations of instrumented grizzly bears from 1975-81 that were within the boundaries of a mapped area were pooled. The relocations with community site analysis data from ground examination were compared with the mapped communities. A set of discriminating variables was selected which was expected to measure the characteristics most likely to differ between the two groups.

The variables selected by the analysis as most discriminating were then used in the function to classify the pooled data into the two original groups: Communities used by grizzly bears, and communities available but not used.

RESULTS

Preliminary analysis was made on one mapped area within the study area on the west edge of Yellowstone Park, north of the town of West Yellowstone, and in the Gneiss Creek and Cougar Creek drainages.

The discriminant analysis indicated certain habitat variables may possibly be used to distinguish between communities available to bears (group 1 = mapped communities) and those communities they are known to use (group 2 = relocation sites).

The variables aspect, slope, habitat type, distance to timber/opening edge, timber cover greater than 3 m tall, and timber cover less than 3 m tall were used to discriminate between the two groups. Twenty-two percent of the difference between the two groups was explained by the variable distance to edge. When this variable was used to classify the pooled data, 66% of the communities were correctly classified at a confidence level of <0.0001.

Stacked histograms and frequency distributions showed that the communities which bears were known to use were usually 11-50 m (47%) or greater than 300 m (32%) from a timber/opening edge.

Further analysis of different areas within different grizzly bear home ranges will need to be done before these preliminary results can be interpreted.

The availability of plant species in the Gneiss Creek/Cougar Creek area (frequency of occurrence in mapped communities) was compared to the frequency of occurrence of these species in the communities known to be used by bears. Twenty species occurred in communities used by bears more frequently than available (Table 20).

These species were ranked by percent frequency at bear use sites and by percent frequency in the entire mapped area. A preference rank for each species was calculated by subtracting availability rank from use rank (Johnson 1980). Greater negative values indicate greater preference. This method indicates grizzly bears prefer communities in which the following species are present: *Poa* spp., *Agropyron* spp., *Carex geyeri*, *Festuca* spp., and *Antennaria* spp. Unfortunately, these species are ubiquitous in distribution and do not indicate certain community types as being preferred by grizzlies.

Table 20. Plant species occurring at grizzly bear use sites in higher proportion than available (Gneiss Cr/Cougar Cr)

	Use sites		Availability		Preference
Plant species	% Freq.	Rank	% Freq.	Rank	rank
Taraxacum officinale	41	1	35	1	0
Poa spp.	38	2	5	6	-4
Antennaria spp.	34	3	4	7	-1
Carex geyeri	31	4	7	5	-1
Salix spp.	28	5	18	2	3
Moss	24	6	16	3	3
Agropyron spp.	17	7	2	8	-1
Festuca spp.	17	7	2	8	-1
Bromus inermis	17	7	9	4	3
Cerastium arvense	17	7	5	6	1
Pinus albicaulis	14	8	7	5	3
Melica spp.	14	8	2	8	0
Bromus anomalus	14	8	7	5	3
Potentilla spp.	10	9	2	8	1
Potentilla glandulosa	10	9	0	9	0
Senecio triangularis	10	9	0	9	0
Delphinium occidentalis	10	9	2	8	1
Lupinus sericeus	10	9	2	8	1
Phlox hoodii	10	9	0	9	0
Juniperus communis	7	10	0	9	1

BURN UTILIZATION

INTRODUCTION

Current data indicate the Yellowstone grizzly bear population is unstable or possibly declining. Mortality and habitat loss directly affect population size and stability and are the only factors we can directly alter. Fire has the potential to greatly alter habitats available to grizzlies. While the values of timbered areas, meadows, and habitat "edges" to grizzly bears have been documented, the use of different aged burned areas had not beenevaluated in the Yellowstone area.

A major proportion of Yellowstone Park is covered by lodgepole pine *(Pinus contorta)* fire-disclimax forests. Fires in lodgepole pine disclimax do not result in traditional successional setback. The burned area usually returns directly to lodgepole pine disclimax. These forests reach maturity at approximately 80 years and subsequently become decadent and more susceptible to wildfire.

The pattern of wildfire in Yellowstone Park has been greatly affected by man. Fire suppression began in 1886, and from 1931 through 1971 over 80% of the fires were suppressed before reaching 0.1 hectare in size. Between the years of 1910 and 1975 only 4.5% of Yellowstone Park had burned. In 1972, the park instituted a new fire management plan which allowed some natural fires to burn.

The historic successful suppression of fires in the park weakens this analysis of grizzly bear utilization of burned areas by creating low availabilities of varying age burns. An average of 88% of each bear's home range was unburned, and no bear had less than 75% of unburned habitat available in its home range (Table 21). Burns from 1910 and before had an average availability of 8.64%, while burns from 1911 through 1981 accounted for only 0.74% of the area within the bears' home ranges.

METHODS

Fire history is available for Yellowstone Park but not for the surrounding national forests. Portions of the home ranges of 27 individual grizzly bears within the park were used to evaluate utilization of different aged burns. These 27 radio-instrumented bears were aerially located 1776 times from 1975 through 1981 within the park. All telemetry locations were made during daylight hours between sunrise and early afternoon.

The composite home range and annual aerial locations of each bear were superimposed on the fire history map. The availability of unburned and burned areas within each home range was calculated with a planimeter. Aerial locations of each bear were tallied by year and by age of burn. Locations on the edge of a burn were counted as in the burn. A separate count was kept of all locations within 200 m of a burned/unburned edge.

Table 21. Occurrence of grizzly bears in unburned and burned areas of Yellowstone National Park, 1975-1981

Bear	Area[1/]	Availability[2/]	Observed[3/]	Expected[4/]	χ^2	*P*[5/]
1	Unburned	86.6%	24	26.4	6.52	n.s.
	Old burns	9.7	5	1.4		
	New burns	3.7	1	1.1		
5	Unburned	97.3	83	84.7	2.74	n.s.
	Old burns	1.1	1	1.0		
	New burns	1.0	3	1.4		
6	Unburned	78.1	110	126.6	37.81	<.005
	Old burns	12.0	31	21.8		
	New burns	10.0	17	9.7		
8	Unburned	97.7	168	166.1	2.90	n.s.
	Old burns	0.9	2	1.5		
	New burns	1.4	0	2.5		
9	Unburned	80.5	19	18.5	-	-
	Old burns	16.3	4	3.8		
	New burns	3.2	0	0.7		
10	Unburned	99.3	21	21.8	-	-
	Old burns	0.6	1	0.1		
	New burns	0.1	0	<0.1		
12	Unburned	75.4	135	160.0	58.78	<.005
	Old burns	16.8	69	37.5		
	New burns	7.8	3	9.5		
14	Unburned	76.8	45	42.7	11.20	n.s.
	Old burns	6.6	10	3.9		
	New burns	16.7	0	8.3		
15	Unburned	87.0	110	110.7	6.89	n.s.
	Old burns	11.0	11	14.0		
	New burns	2.0	6	2.3		
16	Unburned	78.2	63	62.6	5.08	n.s.
	Old burns	16.9	15	13.5		
	New burns	4.9	2	3.9		
19	Unburned	87.7	45	49.1	-	-
	Old burns	10.8	10	6.0		
	New burns	1.5	1	1.5		

Table 21. Occurrence of grizzly bears in unburned and burned areas of, (continued)

Bear	Area[1/]	Availability[2/]	Observed[3/]	Expected[4/]	χ^2	P[5/]
21	Unburned	96.7%	46	45.5	0.28	n.s.
	Old burns	3.1	1	1.4		
	New burns	0.2	0	0.1		
22	Unburned	85.9	43	42.1	1.14	n.s.
	Old burns	13.1	4	6.4		
	New burns	1.0	2	0.5		
26	Unburned	80.9	142	125.5	29.59	<.010
	Old burns	16.2	12	25.0		
	New burns	2.9	0	3.5		
32	Unburned	94.0	17	16.0	-	-
	Old burns	5.9	0	1.0		
	New burns	0.1	0	<0.1		
34	Unburned	99.4	20	19.9	-	-
	Old burns	0	0	0		
	New burns	0.6	0	0.1		
35	Unburned	94.9	41	41.8	3.16	n.s.
	Old burns	3.2	2	1.4		
	New burns	1.9	1	0.9		
36	Unburned	91.2	39	43.8	9.07	<.125
	Old burns	4.0	7	1.9		
	New burns	4.8	2	2.3		
37	Unburned	93.1	22	24.2	3.41	n.s.
	Old burns	0.3	0	0.1		
	New burns	6.6	4	1.7		
38	Unburned	89.2	72	77.6	16.05	<.050
	Old burns	9.0	12	7.8		
	New burns	1.8	3	1.6		
40	Unburned	88.3	53	60.9	15.99	<.010
	Old burns	10.8	13	7.4		
	New burns	1.0	3	0.7		
41	Unburned	91.3	32	32.9	6.87	n.s.
	Old burns	8.4	4	3.0		
	New burns	0.3	0	0.1		

Table 21. Occurrence of grizzly bears in unburned and burned areas of, (continued)

Bear	Area[1]	Availability[2]	Observed[3]	Expected[4]	χ^2	P [5]
42	Unburned	86.1%	22	19.8	-	-
	Old burns	13.9	2	3.2		
	New burns	0	0	0		
50	Unburned	81.4	39	46.4	6.60	<.100
	Old burns	18.6	18	10.6		
	New burns	0	0	0		
51	Unburned	83.8	31	29.3	0.61	n.s.
	Old burns	13.7	4	4.8		
	New burns	2.5	0	0.9		
60	Unburned	98.2	28	31.4	-	-
	Old burns	0.8	4	0.3		
	New burns	1.0	0	0.3		

[1] Old burns = pre-1911; new burns = 1911-1981.
[2] Home range within Yellowstone National Park
[3] Observed number aerial locations.
[4] Expected number of locations = (availability % x total observed)/100.
[5] n.s. = No significant difference between observed and expected.

The technique described by Neu, Byers, and Peek (1974) was used to analyze the burn utilization/availability data. Chi-square evaluation was used to test the hypothesis that a grizzly bear uses burned and unburned habitats in proportion to their occurrence within that bear's home range.

Expected values for locations within different age burns in one bear's home range were calculated by multiplying the total number of aerial locations by availability of each age class of burns. Expected values less than one were not used (Snedecor and Cochran 1967).

Chi-square evaluation tested the goodness of fit of the observed observations to the expected observations. If the observed and expected frequencies were the same, the hypothesis was accepted. If not, the hypothesis was rejected and preference or avoidance of individual burns or unburned areas was determined.

RESULTS

Grizzly bears did not use burned and unburned areas in proportion to their availability. Chi-square evaluation of the occurrence of expected and observed observations in burned versus unburned areas was significant at the 0.005 level.

Further analysis indicated the bears used burned areas more than expected. To determine which burns the bears were using, burns before 1911 were pooled with unburned areas and compared with "newer" burns (1911-1981). The chi-square was significant at the 0.001 level. The chi-square became insignificant when one grizzly bear, No. 6, was omitted from the analysis. The conclusion was that grizzly bears, with the exception of one adult female, used "newer" burns in proportion to their availability.

Grizzly bears occurred more frequently in "old" burns (before 1911) than expected ($\underline{P} < 0.001$) and were observed in unburned areas in proportion to their availability. However, bears were observed more than expected within 200 m of the edge of all burns ($\underline{P} < 0.001$). This data may indicate grizzly bears used "new" burns more often than this analysis reveals. Bears were aerially located only during daylight hours and could have been using burns at night and seeking security within the unburned timbered edges during the day.

Sufficient data were available to evaluate 19 individual grizzly bears. When use of unburned areas, burns before 1911 ("old"), and burns after 1910 ("new") was compared, no significant difference was observed for 12 of these bears. A significant difference in use of these areas was observed for the other seven grizzly bears ($\underline{P} < 0.125$-0.010). Five of these seven bears used "old" burns more than expected and unburned areas less. One used "old" burns less than expected and unburned areas more. The remaining bear was the only grizzly bear evaluated that used "new" burns out of proportion to their availability. The home range of this adult female (No. 6) was located in the Heart Lake/southwest Yellowstone Lake area of Yellowstone Park. Her range contained one of the highest proportions of "new" burns (10%) of the 26 home ranges evaluated (average = 0.74%).

As more fires are allowed to burn within the park, higher proportions of younger aged burns will become available to grizzly bears. This may alter the results of this analysis as the sample size for "new" burns increases.

SUMMARY

1. This analysis applies only to Yellowstone Park and areas of similar vegetation.

2. Historic fire suppression has resulted in low availabilities of burns less than 70 years old.

3. Grizzly bears used unburned habitats in proportion to their availability (passive usage).

4. Grizzly bears used "old burns" (>70 years old) more frequently than expected (selective usage).

5. Grizzly bears used "new burns" (<70 years old) in proportion to their availability (passive usage).

6. Grizzly bears used the unburned edges (200 m wide) of all burns more than expected (selective usage).

7. Some individual grizzly bears do not follow the above general observations.

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1981 WORK PLAN

The attached general work plan for the period 1981-88 was approved by the Steering Committee on 13 March 1981. This specific work plan for the 1981 field season follows the priorities approved by the Steering Committee. During 1981 there will be 3 field crews, 1 graduate student working on classification of riparian habitat, and 1 graduate student on bear use of microhabitats. All work in the following work plan will be accomplished by the 3 field crews and the Montana Fish, Wildlife and Parks wildlife laboratory.

Major objectives for 1981 are as follows:

I. Obtain as much data as possible on early spring and late fall food habits and habitat use.

II. Capture and reinstrument yearlings and 2-year-old bears instrumented in 1980 with the addition of any new bears that are caught in the process.

III. Continue community analysis mapping of areas needed for discriminate function analysis of habitat preference.

Spring and fall habitat use and food habits will be investigated by field examination of sites where instrumented bears are located by aerial tracking. Using this procedure, a community analysis is made at the use site noting plant communities, topography, and items that attracted bears. Scats are collected as encountered. Sites used by bears that are encountered while traveling to and from use sites of instrumented bears are also examined.

Capture and reinstrumentation of young bears will be accomplished by means of 9 culvert traps already in place, with the addition of 2 culvert traps that will be placed as needed. During portions of the field season, traps will be operated concurrent with work on habitat use and community analysis mapping.

Community analysis mapping will be done in areas known to be familiar to instrumented bears but not commonly used by them. This data is recorded in the same manner as habitat use data and will be compared with the habitat use data using discriminate function analysis to determine habitat preferences.

Effort toward other objectives for 1981 will be on an opportunistic basis. This does not necessarily mean that they are less important than major objectives, only that resources are not available for more intensive effort at this time, more background data is needed before they can justify more effort, or sufficient data has been gathered toward the objective so that only minimal further effort is required.

IV. Population parameters

  - *A*. Population estimates
  - *B*. Reproductive rates
  - *C*. Mortality
  - *D*. Dispersal

V. Effects of wildfire

VI. Aggression

VII. Modeling and monitoring

Data on population parameters will be gathered in the course of activities associated with Objectives *I* and *II*. As time and funds permit, observation flights will be made to obtain ratios of marked to unmarked bears for purposes of population and estimation.

Effects of wildfire on grizzly bears will be estimated by comparing wildfire histories in Yellowstone Park with known habitat use patterns of instrumented bears. Very little field work is involved and most intensive efforts will be made during the 1981-82 winter period. Instrumented bears who have recent wildfires within their home ranges will be monitored as time permits to determine the extent of use of those areas.

Data on aggression will be gathered during trapping and as time and opportunity permit during the summer.

All data will be applied to modeling efforts as analyzed. Data that shows promise of being applicable to monitoring systems will be tested for sensitivity and simplicity of acquisition.

* * * * * *

Attachment 1: GENERAL WORK PLAN, 1981-1988

At the 1979 meeting of the Steering Committee, it was agreed that future work plans would largely reflect research needs called for in the recovery plan. Although the recovery plan is well underway, it will probably not be completed until late summer. The following work plan reflects the needs of the recovery plan, as we now understand it, and the recommendations of the Peer Review Committee commissioned by the Steering Committee.

I. Major Objectives

  A. Population parameters

    1. Population estimation - 1984-85
    2. Reproductive rates - ongoing

    3. Recruitment (cub and yearling survival rates) - ongoing
    4. Mortality - ongoing
    5. Dispersal - ongoing

Techniques and procedures will involve instrumenting bears with radio transmitters. New developments in radio-telemetry will allow us to instrument cubs and yearlings. Fewer radio-tracking flights will be required since movements of instrumented bears will be studied mainly on a monitoring level. More emphasis will be placed on observation flights to obtain population parameter data. Population estimation will be accomplished by Peterson index after intensive trapping efforts in 1983-84. Saturation trapping during 1983 and 1984 will be necessary to determine true sex ratios in the population

B. Habitat use

    1. Early spring and late fall use - 1981-83
    2. Effects of wildfire - 1982
    3. Habitat preferences - 1981-83
    4. Daily habitat use patterns - 1981-83
    5. Habitat (modification) (manipulation) (bug-killed trees and wildfire) - 1982

We now have nearly adequate data on general habitat use and food habits of Yellowstone grizzly bears. Additional data is needed for early spring and late fall.

Effects of wildfire will be analyzed using known home range data and historical fire data from Yellowstone Park.

Habitat preference and selection will be investigated through comparison of the plant community composition of areas with differing intensities of bear use.

C. Develop monitoring indices from modeling - ongoing
D. Data analysis, modeling - ongoing

II. Minor objectives

A. Distribution - monitoring
B. Movements - monitoring
C. Food habits and summer habitat use - monitoring status

    1. Spring ungulate use
    2. Riparian habitat classification
    3. Community analysis of use sites (summer feed sites)
    4. Scat collection and analysis
    5. Ant species collection and identification
    6. Plant food collection and succulence determination
    7. Whitebark pine production - monitoring

D. Aggression

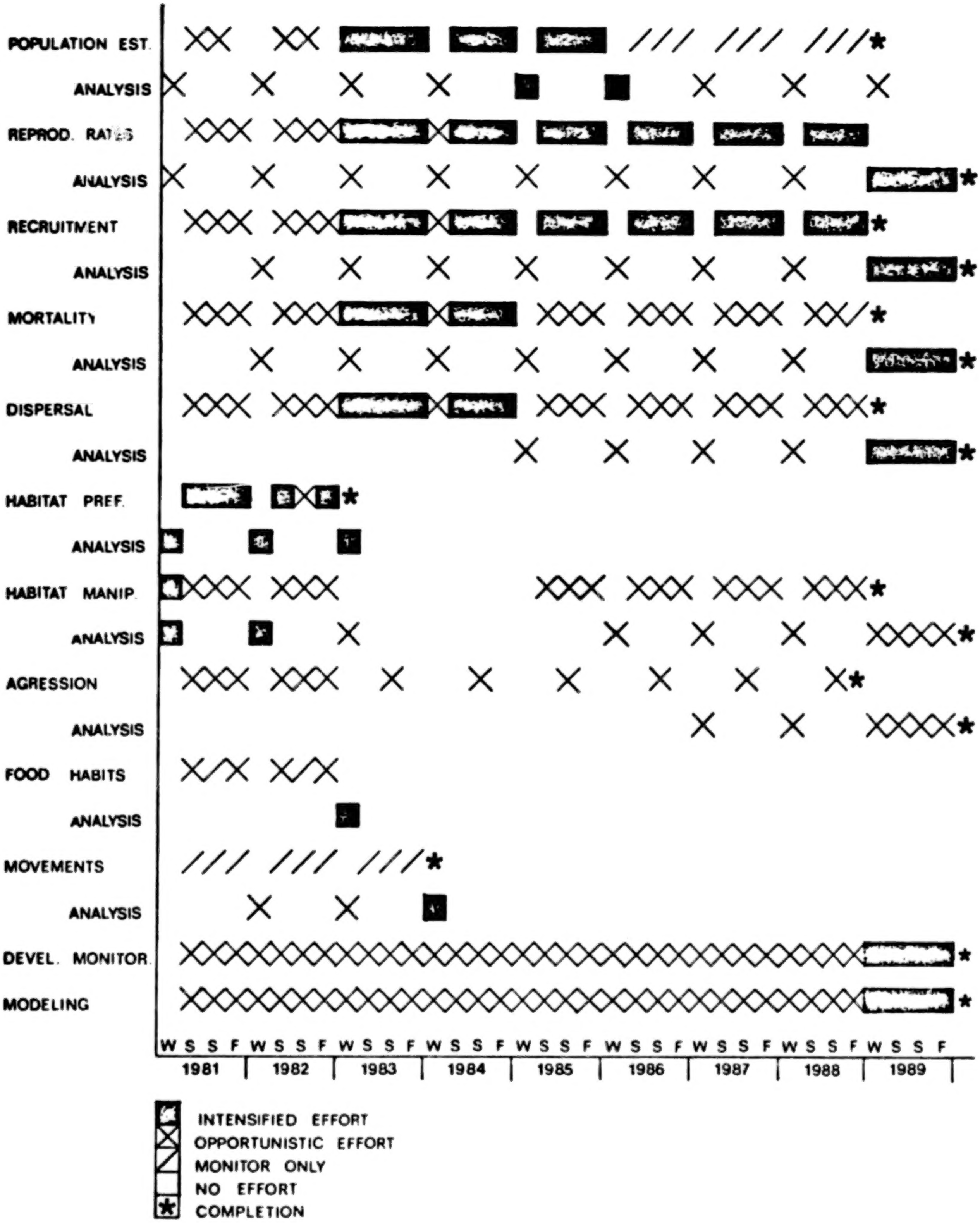
Aggression of grizzlies toward humans will be studied by determining flight distance for individual grizzlies, both marked and unmarked; and by determining adrenaline level differences of individual trapped animals from urine catecholamine levels. Possible relations among flight distances, adrenaline levels, and coat color will be investigated.

Several aspects of food habits and habitat use will be studied to supplement areas in which data is insufficient. Emphasis will be placed on obtaining spring and fall information, including spring use of ungulates as a food source.

A graduate student will be working on a riparian habitat classification.

Scats will be collected throughout the year and analyzed. Ant species utilized as food will be collected and identified. Plant parts eaten will be sampled and analyzed for moisture content. Whitebark pine cone production throughout the study area will be monitored. Plant community analysis of bear use sites will be conducted at randomly selected bear locations, with emphasis on spring and fall seasons.

The 1981-88 General Work Plan was approved by the Steering Committee on 13 March 1981.



Interagency Grizzly Bear Study Team schedule of activities, 1981-1988.

SUMMARY OF AIRCRAFT FLIGHT REPORTS, 1981

Month	Hours flown	No. flights	Bears obs.		Bears/flight		Bears/hr	
			Black	Griz	Black	Griz	Black	Griz
Jan	4.7	2	0	0				
Feb	4.0	1	0	0				
Mar	13.8	4	0	0				
Apr	15.7	4	0	3		0.75		0.19
May	36.3	7	11	17	1.57	2.43	0.30	0.47
Jun	57.9	10	12	11	1.20	1.10	0.21	0.19
Jul	57.9	12	9	35	0.75	2.92	0.16	0.61
Aug	76.5	17	15	38	0.88	2.24	0.20	0.50
Sep	53.0	11	0	12		1.09		0.23
Oct	40.1	9	0	5		0.56		0.13
Nov	22.4	6	0	1		0.17		0.05
Dec	3.5	1	0	0				
Total	385.6	84	47	122	0.56	1.45	0.12	0.32

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END

11-3-82